PROJECT MANUAL

Herkimer Hyphen Addition

Grand Rapids, Michigan

ARCHITECT'S PROJECT NO.	09-026-H
MSHDA PROJECT NO.	3507
OWNER/ SPONSOR:	Herkimer Apartments LDHA LP 101 Sheldon Boulevard, SE Suite 2 Grand Rapids, MI 49503
ARCHITECT:	DTS + WINKELMANN, LLC 64 Division Avenue South Grand Rapids, MI 49503
CIVIL ENGINEER:	Land & Resource 3800 West River Drive. Suite A Comstock Park, MI 49321
STRUCTURAL ENGINEER:	Nehil Sivak Consulting Structural Engineers 414 South Burdick Street Suite 300 Kalamazoo, MI 49007
MEP ENGINEER:	Apollo Engineering, LLC 12719 S. West Bayshore Dr. Traverse City, MI 49684
ISSUE DATE FOR PERMITS:	August 31, 2012
REVISED:	

SIGNATORIES

MORTGAGEE: **Michigan State Housing Development Authority**

Signature:_____ Date:_____

MORTGAGOR: **Herkimer Apartments LDHA LP**

Signature:_____ Date:_____

ARCHITECT: **DTS + Winkelmann, LLC**

Signature:_____ Date:_____

CONTRACTOR: **Rockford Construction Company, Inc.**

Signature:_____ Date:_____

INVESTOR FUND **Great Lakes Capital Fund**

Signature:_____ Date:_____

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This form is issued under authority of Act 346 P.A. 1966. Execution of this form is required. Failure to execute this form may result in denial of a mortgage loan by the Michigan State Housing Development Authority.

MICHIGAN DEPARTMENT OF COMMERCE

MICHIGAN STATE HOUSING DEVELOPMENT AUTHORITY
735 E. Michigan Avenue
Lansing, Michigan 48909

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

ARTICLE I – CONTRACT DOCUMENTS

1.1. DEFINITIONS

1.1.1. THE CONTRACT

The Contract is as defined in Section 101 of the Construction Contract. The Contract represents the entire and integrated agreement between the parties hereto and supersedes all prior negotiations, representations, or agreements, either written or oral, including any bidding documents. The Contract may be amended or modified only by a modification as defined in Paragraph 1.1.2 hereof.

1.1.2. MODIFICATIONS

All modifications shall be part of the Contract Documents. A Modification is (1) a written amendment to the Contract signed by both parties and approved by an Authorized Officer of the Authority; (2) a Change Order under Paragraph 13.1.2. hereof; (3) a written interpretation issued by the Architect pursuant to Paragraph 1.2.4. hereof; or (4) a written order for a minor change in the Work issued by the Architect pursuant to Paragraph 2.2.12 hereof. A Modification may be made only after execution of the Contract.

1.1.3. THE WORK

The term Work includes all labor necessary to produce the construction required by the Contract Documents, and all materials and equipment incorporated or to be incorporated in such construction.

1.1.4. THE DEVELOPMENT

The Development is the total construction designed by the design architect and evidenced by the Contract Document Drawings and Specifications, with Modifications, if any, and including the Property as defined in the Construction Contract.

1.2. EXECUTION, CORRELATION, INTENT AND INTERPRETATIONS

1.2.1. The Contract Documents shall be signed in not less than triplicate by the Owner and Contractor plus such other duplicate originals as may be required by the Authority and any other governmental agencies having jurisdiction over the Development. If either the Owner or the Contractor or both do not sign the General Conditions of the Contract for Construction,

Drawings, Specifications, or any of the other Contract Documents, those accepted for filing by the Authority shall control.

1.2.2. The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all. They are intended to agree and be mutually explanatory, and shall be accepted and used as a whole and not separately. Notwithstanding any other language in the Contract Documents to the contrary, the terms of the Construction Contract shall prevail over all other Contract Documents in the event of conflict; as between the Drawings and the Specifications, the terms of the Specifications shall prevail over any inconsistent provision in the Drawings. The intention of the documents is to include all labor, materials, equipment and other items as provided in Paragraph 4.4.1 hereof necessary for the proper execution and completion of the Work. It is not intended that Work not covered under any heading, section, branch, class or trade of the Specifications shall be supplied unless it is required elsewhere in the Contract Documents or is reasonably inferable therefrom as being necessary to provide the intended results. Words which have well-known technical or trade meanings are used herein in accordance with such recognized meanings.

1.2.3. The organization of the Specifications into divisions, sections and articles, and the arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

1.2.4. Written interpretations necessary for the proper execution or progress of the Work, in the form of drawings or otherwise, will be issued with reasonable promptness by the Architect and in accordance with any schedule agreed upon. Such interpretations shall be consistent with and reasonably inferable from the Contract Documents, and may be effected by Field Order.

1.3 COPIES FURNISHED AND OWNERSHIP

1.3.1. Unless otherwise provided in the Contract Documents, the Contractor shall be furnished, without charge, six (6) complete sets of the Drawings and Specifications.

1.3.2. All Drawings, Specifications and copies thereof furnished by the Architect are and shall remain his property. They are not to be used on any other housing development, and, with the exception of one contract set for each party to the Contract and one set for the Authority, are to be returned to the Architect on request at the completion of the Work.

ARTICLE II – ARCHITECT

2.1. As used in these General Conditions of the Contract for Construction, the term Architect shall mean the person or organization identified in the Construction Contract as the Architect Administering the Construction Contract whenever the context herein contemplates the performance of services in the field at the Development site or as to these General Conditions, the term Architect shall mean the person or organization identified in the Construction Contract as having prepared the Drawings and Specifications. When, in the course of the work of the Architect Administering the Construction Contract, such Architect is requested to perform work of the Architect who prepared the Drawings and Specifications, or such Architect becomes aware of work to be performed by the Architect who prepared the Drawings and Specifications, it shall be the duty of such Architect Administering the Construction Contract to notify the Architect who prepared the Drawings and Specifications to perform such work, and the performance of such work by the Architect who prepared the Drawings and Specifications shall be coordinated with the performance of other elements of the Work. The Architect is referred to throughout the Contract Documents as if singular in number and masculine in gender.

2.1.2. Nothing contained in the Contract Documents shall create any contractual relationship between the Architect and the Contractor.

2.2 ADMINISTRATION OF THE CONTRACT

2.2.1. The Architect will provide general administration of the Construction Contract, including performance of the functions hereinafter described.

2.2.2. The Architect will be the Owner's representative during construction and until final payment and for purposes of one or more inspections during the applicable warranty period. The Architect will have authority to act on behalf of the Owner to the extent provided in the Contract Documents, unless otherwise modified in writing, copies of the written modification shall be delivered to the Contractor and the Authority. The Architect will advise and consult with the Owner and the Authority, and all of the Owner's instructions to the Contractor shall be issued through the Architect.

2.2.3. The Architect shall at all times have access to the Work wherever it is in preparation and progress. The Contractor shall provide facilities for such access adequate for the Architect to perform his functions under the Contract Documents.

2.2.4. The Architect will make periodic visits to the site to familiarize himself with the progress and quality of Work and to determine if the Work is proceeding in accordance with the Contract Documents. On the basis of his on-site observations, he will guard the Owner against defects and deficiencies in the Work of the Contractor. The Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not be responsible for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, and he will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents.

2.2.5. Based on the Architect's observations and the Contractor's Applications for Payment, the Architect will determine the amounts owing to the Contractor and will execute Certificates for Payment in such amounts, in accordance with Section 10.3 hereof.

2.2.6. The Architect will be, in the first instance, the interpreter of the Contract Documents and the judge of the performance thereunder by both the Owner and Contractor. In the event of a disagreement between the Architect and the Authority as to interpretation of the Contract Documents or as to performance of the Owner and Contractor thereunder, then the interpretation of an Authorized Officer of the Authority shall control. The Architect will render promptly such interpretations as may be necessary for the proper execution or progress of the Work.

2.2.7. Claims, disputes and other matters in question between the Contractor and the Owner relating to the execution of progress of the Work or the interpretation of the Contract Documents shall be referred initially to the Architect for decision, which decision he will render promptly in writing.

2.2.8. All interpretations and decisions of the Architect shall be consistent with the intent of the Contract Documents. In his capacity as interpreter and judge, he will exercise his best efforts to insure faithful performance by both the Owner and the Contractor and will not show partiality to either.

2.2.9. The Architect's decisions in matters relating to artistic effect will be final if consistent with the intent of the Contract Documents except as provided in Paragraph 2.2.18 hereof.

2.2.10. The Architect will have authority to reject Work which does not conform to the Contract Documents. Whenever, in his reasonable opinion, he considers it necessary or advisable to ensure the proper implementation of the intent of the Contract Documents, he will have authority to require the Contractor to stop the Work or any portion thereof, or to require special inspection of testing of the Work as provided in Paragraph 8.6.2 hereof whether or not such work be then fabricated, installed or completed. However, neither the Architect's authority to act under this Paragraph 2.2.10 nor any decision made by him in good faith either to exercise or not to exercise such authority, shall give rise to any duty or responsibility of the Architect to the Contractor any Subcontractor, any of their agents or employees, or any other person performing any of the Work.

2.2.11. The Architect will review Shop Drawings and Samples as provided in Paragraphs 4.12.1 through 4.12.8 hereof inclusive.

2.2.12. The Architect will prepare Change Orders in accordance with Article XIII hereof, and will have authority to order minor changes in the Work as provided in Paragraph 13.3.1 hereof.

2.2.13. The Architect will conduct inspections to determine the date of Final Completion as provided in the Construction Contract, will receive written guarantees and related documents required by the Contract and assembled by the Contractor, and will execute a final Certificate for Payment as required by the Construction Contract.

2.2.14. The duties, responsibilities and limitations of authority of the Architect as the Owner's representative during construction as set forth in these General Conditions will not be modified or extended without written consent of the Owner, the Architect and an Authorized Officer of the Authority, a copy of which written consent shall be provided to the Contractor.

2.2.15. The Architect will not be responsible for the acts or omissions of the Contractor, any Subcontractors, or any of their agents or employees, or any other persons performing any of the Work.

2.2.16. In case of the termination of the employment of the Architect, the Owner shall appoint an architect as to whom the Contractor and the Authority make no reasonable objection, whose status under the Contract Documents shall be that of the former Architect.

2.2.17. The Architect immediately shall furnish the Owner and the Authority with copies of all Field Orders, proposed Change Orders, proposed Orders for Extra Work, interpretations and all other documents prepared and executed by him during the construction period and until final payment.

2.2.18. The Architect will furnish all color and material samples to the Authority or its representative. The Architect's decision regarding color or material samples shall be subject to the approval of an Authorized Officer of the Authority.

ARTICLE III – OWNER

3.1 DEFINITION

3.1.1. The Owner is the person or organization identified as such in the Construction Contract and is referred to throughout the Contract Documents as if singular in number and masculine in gender. The term Owner means the Owner or his authorized representative.

3.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

3.2.1. The Owner shall furnish an initial survey describing the physical characteristics, legal limits and utility locations for the Property.

3.2.2. The Owner shall secure and pay for easements for permanent structures or permanent changes in existing facilities.

3.2.3. Information or services under the Owner's control shall be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

3.2.4. The Owner shall issue all instructions to the Contractor through the Architect.

3.2.5. The foregoing are in addition to other duties and responsibilities of the Owner enumerated herein and especially those in respect to payment in Article X hereof.

ARTICLE IV – CONTRACTOR

4.1. DEFINITION

4.1.1. The Contractor is the person or organization identified as such in the Construction Contract and is referred to through the Contract Documents as if singular in number and masculine in gender. The term Contractor means the Contractor or his authorized representative.

4.2. REVIEW OF CONTRACT DOCUMENTS

4.2.1. The Contractor shall carefully study and compare the Construction Contract, these General Conditions of the Contract for Construction, Drawings, Specifications, Addenda and Modifications and shall at once report to the Architect any error, inconsistency or omission he may discover. The Contractor shall do no Work without Drawings, Specifications, interpretations or Modifications.

4.3 SUPERVISION AND CONSTRUCTION PROCEDURES

4.3.1. The Contractor shall supervise and direct the Work, using his best skill and attention. He shall be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract Documents.

4.4 LABOR AND MATERIALS

4.4.1. Unless otherwise specifically noted, the Contractor shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, permits, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

4.4.2. The Contractor shall at all times enforce strict discipline and good order among his employees.

4.5 WARRANTY

4.5.1. The Contractor warrants to the Owner and the Architect that all materials and equipment furnished under this Contract will be new unless otherwise specified by the Contract Documents and that all Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. All Work not so conforming to these standards including substitutions not properly approved and authorized, may be considered defective. If required by the Architect or an Authorized Officer of the Authority, the Contractor shall furnish satisfactory evidence as to the kind and quality of the Work.

4.5.2. The Warranty provided in this Section 4.5 shall be in addition to and not in limitation of any other Warranty or remedy required or provided by law or by the Contract Documents.

4.6 TAXES

4.6.1. The Contractor shall pay all sales, consumer, use and other similar taxes required by law.

4.7 CASH ALLOWANCES

4.7.1. The Total Contract Sum includes all allowances stated in the Contract Documents. These allowances shall cover the net cost of the materials and equipment delivered and unloaded at the site, and all applicable taxes. The Contractor's handling costs on the site, labor, installation costs and overhead are included in the Total Contract Sum and not in the allowance. If the cost, when determined, is more than or less than the allowance, the Total Contract Sum shall be adjusted accordingly by Change Order which will include overhead.

4.8 SUPERINTENDENT

4.8.1. The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Development site during the progress of the Work. The superintendent shall be satisfactory to the Architect, and shall not be changed except with the consent of the Architect, unless the superintendent proves to be unsatisfactory to the Contractor and ceases to be in his employ. The superintendent shall represent the Contractor and all communications given to the superintendent shall be as binding as if given to the Contractor. Important communications will be confirmed in writing. Other communications will be so confirmed on written request in each case.

4.9 RESPONSIBILITY FOR THOSE PERFORMING THE WORK

4.9.1. The Contractor shall be responsible to the Owner for the acts and omissions of all his employees, all Subcontractors and all Sub-subcontractors, their agents and employees, and all other persons performing any of the Work under a contract with the Contractor.

4.10 PROGRESS SCHEDULE

4.10.1 The Contractor, immediately after being awarded the Contract, shall prepare and submit to the Architect and the Authority an estimated progress schedule for the Work, for their approval. The progress schedule shall be related to the entire Development to the extent required by the Contract Documents. This schedule shall indicate the dates for the starting and completion of the various stages of construction and shall be revised as required by the

conditions of Work, subject to the approval of the Architect and an Authorized Officer of the Authority.

4.11 DRAWINGS AND SPECIFICATIONS AT THE SITE

4.11.1. The Contractor shall maintain at the site for the Owner and the Authority one copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Change Orders and other Modifications, in good order and marked to record all changes made during construction. These shall be available to the Architect and the Authority. The Drawings, marked to record all changes made during construction, shall be delivered to the Architect for the Owner upon completion of the Work.

4.12 SHOP DRAWINGS AND SAMPLES

4.12.1. Shop Drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data which are prepared by the Contractor or any Subcontractor, manufacturer, supplier or distributor, and which illustrate some portion of the Work.

4.12.2. Samples are physical examples furnished by the Contractor to illustrate materials, equipment or workmanship, and if, accepted, to establish standards by which the Work will be judged.

4.12.3. The Contractor shall review, stamp with his approval and submit, with reasonable promptness and in order sequence so as to cause no delay in the Work or in the work of any other contractor, all Shop Drawings and Samples required by the Contract Documents or subsequently by the Architect as covered by Modifications. Shop Drawings and Samples shall be properly identified as specified, or as the Architect may require. At the time of submission the Contractor shall inform the Architect in writing of any deviation in the Shop Drawings or Samples from the requirements of the Contract Documents.

4.12.4. By approving and submitting Shop Drawings and Samples, the Contractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, catalog numbers and similar data, or will do so, and that he has checked and coordinated each Shop Drawing and Sample with the requirements of the Work and of the contract Documents.

4.12.5. The Architect will review and approve Shop Drawings and Samples with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the Development and with the information given in the Contract Documents. The Architect's approval of a separate item shall not indicate approval of an assembly in which the item functions.

4.12.6. The Contractor shall make any corrections required by the Architect or an Authorized Officer of the Authority and shall resubmit the required number of corrected copies of Shop Drawings or new Samples until approved. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings to revisions other than the corrections requested by the Architect on previous submissions.

4.12.7. The Architect's approval of Shop Drawings or Samples shall not relieve the Contractor of responsibility for any deviation from the requirements of the contract Documents unless the Contractor has informed the Architect in writing of such deviation at the time of submission and the Architect has given written approval to the specific deviation, nor shall the Architect's approval relieve the Contractor from responsibility for errors or omissions in the Shop Drawings or Samples.

4.12.8. No portion of the Work requiring a Shop Drawing or Sample submission shall be commenced until the submission has been approved by the Architect. All such portions of the Work shall be in accordance with approved Shop Drawings and Samples.

4.13 USE OF THE PROPERTY

4.13.1. The Contractor shall confine operations at the Property to activities permitted by law, ordinances, permits and the Contractor Documents and shall not unreasonable encumber the Property with any materials or equipment.

4.14 CUTTING AND PATCHING OF WORK

4.14.1. The Contractor shall do all cutting, fitting or patching of the Work that may be required to make its several parts fit together properly, and shall not endanger any Work by cutting, excavating or otherwise altering the Work or any part of it.

4.15 CLEANING UP AND BROKEN GLASS

4.15.1. The Contractor at all times shall keep the premises free from accumulation of waste materials or rubbish caused by his operation. At the completion of the Work he shall remove all his waste materials and rubbish from and about the Development as well as all his tools, construction equipment, machinery and surplus materials. The Contractor shall be responsible for all broken glass, and at the completion of the Work he shall replace, at his own expense, all such damaged or broken glass. After all broken glass has been replaced, the Contractor shall remove all labels and wash and polish both sides of all glass.

In addition, to general broom cleaning and subcontractors' cleaning, the Contractor shall perform the following final cleaning for all trades at completion of the Work:

1. Remove temporary protections;

2. Remove marks, stains, fingerprints and other soil and dirt from painted, decorated, and other finish materials and wash or wipe clean;

3. Remove spots, mortar, plaster, soil and paint from ceramic tile and wash or wipe clean;

4. Clean fixtures, cabinetwork and equipment, removing stains, paint, dirt and dust and leave in undamaged, new-appearing condition;

5. Clean floors thoroughly with a well-rinsed mop containing only enough moisture to clean off any surface dirt or dust.

4.15.2. If the Contractor fails to clean up, the Owner may do so and the cost thereof shall be charged to the Contractor as provided in Section 8.4 hereof.

4.16 COMMUNICATIONS

4.16.1. The Contractor shall forward all communication to the Owner through the Architect.

4.16.2. The Contractor, Owner and Architect shall forward all communications to the Authority as indicated for the purpose of notice in the Construction Contract.

4.17 INDEMNIFICATION

4.17.1. The Contractor shall indemnify and hold harmless the Owner and Architect and their agents and employees from and against all claims, damages, losses and expenses including but not limited to attorney's fees arising out of or resulting from the performance of the Work, providing that any such claim, damage, loss or expense (a) is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting thereform, and (b) is caused in whole or in part by any negligent act or omission of the Contractor, and Subcontractor, anyone directly or indirectly employed by any of them or anyone for those acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person as described in this Paragraph 4.17.

4.17.2. In any and all claims against the Owner or the Architect or any of their agents or employees by an employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Section 4.17 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under workmen's compensation acts, disability benefit acts or other employee benefit acts.

4.17.3. The obligations of the Contractor under this Section 4.17 shall not extend to the liability of the Architect, his agents or employees arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications, or (2) the giving of or the failure to give directions or instructions by the Architect, his agents or employees.

ARTICLE V – THE AUTHORITY

5.1 DEFINITION

5.1.1. The Authority is the Michigan State Housing Development Authority, a public body corporate and politic of the State of Michigan.

5.2 RIGHTS OF THE AUTHORITY

5.2.1. For the purpose of protecting its interest in the Development as lender under the Act, the Authority has been granted such rights as are provided in the Contract Documents.

5.3 AUTHORITY APPROVALS

5.3.1. No Change Order, order for extra work or other instrument which changes the terms of the Contract Documents may be made without the written approval of the Authority. Such approvals shall be a condition precedent to any compensation to the Contractor for extra or additional work performed pursuant to any Change Order or other instrument which changes the terms of the Contract Documents.

5.3.2. Except as otherwise provided herein, whenever any approval or notice by the Authority is required under these General Conditions, or whenever any action by the Authority is required or permitted, an Authorized Officer of the Authority as described in Section 204 of the Construction Contract (Legal 016) shall have the power and right to approve, give notice or act on behalf of the Authority.

ARTICLE VI – SUBCONTRACTORS

6.1 DEFINITION

6.1.1. A Subcontractor is a person or organization who has a direct contract with the Contractor to perform any of the Work at the site. The term Subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Subcontractor or his authorized representatives.

6.1.2. A Sub-subcontractor is a person or organization who has a direct or indirect contract with a Subcontractor to perform any of the Work on the Property. The term Sub-subcontractor is referred to through the Contract Documents as if singular in number and masculine in gender and means a Sub-subcontractor or an authorized representative thereof.

6.1.3. The Contractor shall not make any substitutions for any Subcontractor or person or organization who has been accepted by the Owner or the Architect and any Subcontractor or Sub-subcontractor.

6.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

6.2.1. The Contractor shall not contract with any Subcontractor proposed for the principal portions of the Work who has not been accepted by the Owner and the Architect and as to whom no objection has been made by an Authorized Officer of the Authority within ten (10) days after written notice of the proposed selection of such Subcontractor has been given to the Authority by the Contractor. The Contractor will not be required to contract with any subcontractor or person or organization against whom he has a reasonable objection.

6.2.2. If the Owner or the Architect requires a change of any proposed Subcontractor or person or organization previously accepted by them, the Total Contract Sum shall be increased or decreased by the difference in cost occasioned by such change and an appropriate Change Order shall be issued, subject to the written approval of an Authorized Officer of the Authority.

6.2.3. The Contractor shall not make any substitutions for any Subcontractor or person or organization who has been accepted by the Owner, the Architect and the Authority, unless the substitution is acceptable to the Owner, the Architect and an Authorized Officer of the Authority.

6.3 SUBCONTRACTUAL RELATIONS

6.3.1. All work performed for the Contractor by a Subcontractor shall be pursuant to an appropriate agreement between the Contractor and the Subcontractor (and where appropriate between Subcontractors and Sub-subcontractors) which, in addition to requirements of the Construction Contract shall contain provisions that:

1. preserve and protect the rights of the Owner and the Architect under the Contract with respect to the Work to be performed under the subcontract so that the subcontracting thereof will not prejudice such rights;

2. require that such Work be performed in accordance with the requirements of the Contract Documents;

3. require submission to the Contractor of applications for payment under each subcontract to which the Contractor is a party, in reasonable time to enable the Contractor to apply for payment in accordance with the Construction Contract;

4. require that all claims for additional costs, extensions of time, damages for delays or otherwise with respect to subcontracted portions of the Work shall be submitted to the Contractor (via any Subcontractor or Sub-subcontractor where appropriate) in the manner provided in the Contract Documents for like claims by the Contractor upon the Owner; and

5. obligate each Subcontractor specifically to consent to the provisions of the Section 6.3.

6.4 PAYMENTS TO SUBCONTRACTORS

6.4.1. The Contractor shall pay each Subcontractor an amount equal to the percentage of completion allowed to the Contractor on account of such Subcontractor's Work. The Contractor shall also require each Subcontractor to make similar payments to his subcontractors.

6.4.2. The Architect may, on request and at his discretion, furnish to any Subcontractor, if practicable, information regarding percentages of completion certified to the Contractor on account of Work done by such Subcontractors.

6.4.3. Neither the Owner, the Authority, nor the Architect shall have any obligation to pay or to see to the payment of any monies to any Subcontractor except as may otherwise be required by law.

ARTICLE VII – SEPARATE CONTRACTS

7.1 OWNER'S RIGHT TO AWARD SEPARATE CONTRACTS

7.1.1. The Owner reserves the right to award other contracts in connection with other portions of the Development under these or similar General Conditions of the Contract for Construction, subject to the prior written approval of any Authorized Officer of the Authority.

7.1.2. The Owner will provide for the coordination of the work of his own forces and of each separate contractor with the Work of the Contractor, who shall cooperate therewith as provided in Paragraph 7.2.

7.1.3. When separate contracts are awarded for different portions of the Development, "the Contractor" in the Contract Documents in each case shall be the contractor who signs each separate contract.

7.2 MUTUAL RESPONSIBILITY OF CONTRACTORS

7.2.1. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and shall properly connect and coordinate his Work with theirs.

7.2.2. If any part of the Contractor's Work depends for proper execution or results upon the work of any other separate contractor, the Contractor shall inspect and promptly report to the Architect any apparent discrepancies or defects in such work that render it unsuitable for

such proper execution and results. Failure of the Contractor so to inspect and report shall constitute an acceptance of the contractor's work as fit and proper to receive his work, except as to defects which may develop in the other separate contractor's work after the execution of the Contractor's Work.

7.2.3. Should the Contractor cause damage to the work or property of any separate contractor on the Development, the Contractor shall, upon due notice, settle with such other contractor by agreement or arbitration, if he will so settle. If such separate contractor sues the Owner on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor who shall defend such proceedings at the Owner's expense, and if any judgment against the Owner arises therefrom the Contractor shall pay or satisfy it and shall reimburse the Owner for all Attorney's fees and court costs which the Owner has incurred.

7.3 CUTTING AND PATCHING UNDER SEPARATE CONTRACTS

7.3.1. The Contractor shall do all cutting, fitting or patching of his Work that may be required to fit it to receive or be received by the Work of other contractors shown in the Contract Documents. The Contractor shall not endanger any work of any other contractors by cutting, excavating or otherwise altering any work and shall not cut or alter the work of any other contractor except with the written consent of the Architect.

7.3.2. Any costs caused by defective or ill-timed work shall be borne by the party responsible therefor.

7.4 OWNER'S RIGHT TO CLEAN UP

7.4.1. If a dispute arises between the separate contractors as to their responsibility for cleaning up as required by Section 4.15 hereof, the Owner may clean up and charge the cost thereof to the several contractors as the Architect may determine to be just.

ARTICLE VIII – MISCELLANEOUS PROVISIONS

8.1 LAW OF THE PLACE

8.1.1. The Contract shall be governed by the law of the State of Michigan.

8.2 SUCCESSORS AND ASSIGNS

8.2.1. The Owner and the contractor each binds himself, his partners, successors, assigns and legal representatives of such other party in respect to all covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract or sublet it as a whole without the written consent of the other and the prior written consent of an Authorized Officer of the Authority, nor shall the Contractor assign any monies due or to become due to him hereunder, without the prior written consent of the Owner and an Authorized Officer of the Authority.

8.3 CLAIMS FOR DAMAGES

8.3.1. Should either party to the Contract suffer injury or damage to person or property because of any act or omission of the other party or of any of his employees, agents or others for whose acts he is legally liable, claim shall be made in writing to such other party within a reasonable time after the first observance of such injury or damage.

8.4 OWNER'S RIGHT TO STOP AND/OR CARRY OUT THE WORK

8.4.1. If the Contractor fails to correct defective Work as required by Paragraph 14.2 or persistently fails to carry out the Work in accordance with the Contract Documents, the Owner, by a written order signed personally or by an agent specifically so empowered by the Owner in writing, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not have rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Subparagraph 7.1.2.

8.4.2. If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents or fails to perform any provision of the Contract, after seven (7) days written notice to the Contractor and without prejudice to any other remedy he may have, the Owner may make good such deficiencies. In such case an appropriate Change Order shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies, including the cost of the Architect's additional services made necessary by such default, neglect or failure. The Architect must approve both such action and the amount charged to the Contractor. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

8.5 ROYALTIES AND PATENTS

8.5.1. The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and shall save the Owner harmless from loss on account thereof, except that the Owner shall be responsible for all such loss when a particular design, process, or the product of a particular manufacturer or manufacturers is specified, but if the Contractor has reason to believe that the design, process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the Architect.

8.6 TESTS

8.6.1. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested, or approved, the Contractor shall give the Architect and the Authority timely notice of its readiness and of the date arranged so the Architect and representatives of the Authority may observe such inspection, testing or approval. The Contractor shall bear all costs of such inspections, tests and approvals unless otherwise provided.

8.6.2. If after the commencement of the Work the Architect determines that any Work requires special inspection, testing or approval which Paragraph 8.6.1 hereof does not include, upon written authorization from the owner, he will instruct the Contractor to order such special inspection, testing or approval, and Contractor shall give notice as in Paragraph 8.6.1 hereof. If such special inspection or testing reveals a failure of the Work to comply (1) with the requirements of the Contract Documents or (2) with respect to the performance of the Work, with laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, the Contractor shall bear all costs thereof, including the cost of Architect's additional services made necessary by such failure; otherwise the Owner shall bear such costs, and an appropriate Change Order shall be initiated.

8.6.3. Required certificates of inspection, testing or approval shall be secured by the Contractor and promptly delivered by him to the Architect and the Authority.

8.6.4. If the Architect is to observe the inspections, tests or approvals required by this Section 8.6, he will do so promptly and, where practicable, at the source of supply.

8.6.5. Neither the observations of the Architect in his Administration of the Construction Contract, nor inspections, tests, or approvals by persons other than the Contractor shall relieve the Contractor from his obligations to perform the Work in accordance with the Contract Documents.

8.7 INTEREST

8.7.1. Any monies not paid when due to either party under this Contract shall bear interest at the legal rate in force in the State of Michigan.

8.8 DISPUTES

8.8.1. In the event of a claim, dispute or any other matters in question arising out of, or relating to this Contract or the breach thereof, except for Owner's refusal to pay the Contractor, upon request of an Authorized Officer of the Authority, such amount as has been previously approved by an Authorized Officer of the Authority, the Contractor warrants that it will carry on the Work and maintain the progress schedule during any proceedings to settle the dispute, unless otherwise agreed by the Contractor and the Owner in writing and approved in writing by an Authorized Officer of the Authority.

8.9 JOB SIGN

8.9.1. The Contractor shall cause to be erected, in a conspicuous place on the Property and at his sole cost and expense, a sign identifying the Development, which sign shall comply with specifications therefor issued by an Authorized Officer of the Authority.

8.10 RIGHTS AND REMEDIES

8.10.1. The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, right and remedies otherwise imposed or available by law.

8.10.2. No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of any right or duty afforded any of them under the Contract, not shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

ARTICLE IX – TIME

9.1 DEFINITIONS

9.1.1. The Contract Time is the period of time allotted in the Contract Documents for completion of the Work.

9.1.2. The date of commencement of the Work is the date established in the Construction Contract.

9.1.3. The term day as used in the Contract Documents shall mean calendar days unless otherwise specifically designated.

9.2 PROGRESS AND COMPLETION

9.2.1. All time limits stated in the Contract Documents are of the essence of the Contract.

9.3 DELAYS AND EXTENSIONS OF TIME

9.3.1. If the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or the Architect, or by any employee of either, or by any separate contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in transportation which was not reasonably foreseeable, adverse weather conditions not reasonably foreseeable, unavoidable casualties or any causes beyond the Contractor's control which were not reasonably foreseeable, or by delay authorized by the Owner pending settlement of a dispute, or by any cause which the Architect, with the written approval of an Authorized Officer of the Authority, determines may justify the delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine with the approval of an Authorized Officer of the Authority.

9.3.2. All claims for extension of time shall be made in writing to the Architect, with a copy to the Authority, no more than five (5) days after the occurrence of the cause for delay; otherwise they shall be waived. Any such claim shall have a caption at the top of the first page, in capital letters, as follows: "NOTICE OF CLAIM FOR EXTENSION OF TIME". The Contractor, shall, as part of such claim, provide an estimate of the probable effect of such delay on the progress of the Work.

9.3.3. If no schedule or agreement is made stating the dates upon which written interpretations as set forth in Paragraph 1.2.4 hereof shall be furnished, then no claim for delay shall be allowed on account of failure to furnish such interpretations until fifteen (15) days after demand is made for them, and not then unless such claim is reasonable.

9.3.4. Except as provided in Section 303 of the Construction Contract, the recovery of damages for delay under other provisions of the Contract Documents is not precluded.

ARTICLE X – PAYMENTS AND COMPLETION

10.1 TOTAL CONTRACT SUM

10.1.1. The Total Contract Sum is stated in the Construction Contract and is the maximum total amount payable by the Owner to the Contractor for the performance of the Work under the Contract Documents.

10.2 ENCUMBRANCES

10.2.1. The Contractor warrants and guarantees that no Work, materials or equipment covered by an Application for Payment will have been acquired by the Contractor or by any other person performing the Work on the Property or furnishing materials and equipment for the Development subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person.

10.3 CERTIFICATES FOR PAYMENT

10.3.1. If the Contractor has made Application for Payment as provided in the Construction Contract, the Architect will, with reasonable promptness but not more than seven

(7) days after the receipt of the Application, execute a Certificate for Payment to the Owner, with copies to the Contractor and Authority, for such amount as he determines to be properly due, or state in writing his reasons for withholding a Certificate as provided in Paragraph 10.4.1 hereof. Such Certificate shall be in the form contained in MSHDA Form No. CD 260, or such other form as may be prescribed or approved by an Authorized Officer of the Authority.

10.3.2 The execution of a Certificate for Payment will constitute a representation by the Architect to the Owner and the Authority, based on his observations at the Development site as provided in Paragraph 2.2.4 hereof and the data comprising the Application for Payment, that the Work has progressed to the point indicated; that, to the best of his knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole upon Final Completion, to the results of any subsequent tests required by or performed pursuant to the Contract Documents, to minor deviations from the Contract Documents correctable prior to completion, and to any specific qualifications stated in his Certificate); and that the Contractor is entitled to payment in the amount certified. In addition, the Architect's final Certificate for Payment will constitute a further representation that the conditions precedent to the Contractor's being entitled to final payment, as set forth in Section 406 of the Construction Contract, have been fulfilled. However, by executing a Certificate for Payment, the Architect shall not thereby be deemed to represent that he has made any examination to ascertain how or for what purpose the Contractor has used the monies previously paid on account of the Total Contract Sum.

10.3.3. After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner, and subject to the conditions, provided in the Construction Contract.

10.3.4. No Certificate for a progress payment, nor any progress payment, nor any partial or entire use or occupancy of the Development by the Owner, shall constitute an acceptance of any Work not in accordance with the Contract Documents.

10.4 PAYMENTS WITHHELD

10.4.1 The Architect may decline to approve an Application for Payment and may withhold his Certificate in whole or in part if, in his opinion, he is unable to make representations to the Owner as provided in Paragraph 10.3.2 hereof. If the Architect is unable to make representations to the Owner as provided in Subparagraph 10.3.2 and to certify payment in the amount of the Application, he will notify the Contractor as provided in Subparagraph 10.3.1. If the Contractor and the Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which he is able to make such representation to the Owner. The Architect may also decline to approve any Applications for Payment, or because of subsequently discovered evidence or subsequent inspections, he may nullify the whole or any part of any Certificate for Payment previously issued, to such extent as may be necessary in his opinion to protect the Owner from loss because of:

1. defective Work not remedied,

2. claims filed or reasonable evidence indicating probable filing of claims,

3. failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment,

4. reasonable doubt that the Work can be completed for the unpaid balance of the Total Contract Sum,

5. damage to another contractor;

6. reasonable evidence that the Work will not be completed within the Contract Time, or

7. persistent failure to carry out the Work in accordance with the Contract Documents.

10.4.2. When the grounds for the withholding of payments in Paragraph 10.4.1 hereof are removed to the extent applicable, payment shall be made for amounts withheld because of them.

10.5 FAILURE OF PAYMENT

10.5.1. If the Architect shall fail to execute any Certificate for Payment, through no fault of the Contractor, within seven (7) days after receipt of the Contractor's Application for Payment, or if the Owner shall fail to pay the Contractor within seven (7) days after the date of payment established in the Construction Contract any amount certified by the Architect and approved by an Authorized Officer of the Authority, the Contractor may, upon seven (7) additional days written notice to the Owner and the Architect, stop the Work until payment of the amount owing has been received.

ARTICLE XI – FINAL PAYMENT

11.1 WAIVER OF ALL CLAIMS

11.1.1. The making of final payment shall constitute a waiver of all claims by the Owner except those arising from:

1. unsettled liens,

2. faulty or defective Work discovered after Final Completion,

3. failure of the Work to comply with the requirements of the Contract Documents, or,

4. the terms of any special guarantees required by the Contract Documents.

11.1.2. The acceptance of final payment shall constitute a waiver of all claims by the Contractor except those previously made in writing and still unsettled.

ARTICLE XII – PROTECTION OF PERSONS AND PROPERTY

12.1 SAFETY PRECAUTIONS AND PROGRAMS

12.1.1. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work.

12.2 SAFETY OF PERSONS AND PROPERTY

12.2.1. The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury, or loss to:

1. all employees on the Work and all other persons who may be affected thereby;

2. all the Work and all materials and equipment to be incorporated therein, whether in storage on or off the Property, under the care, custody or control of the Contractor or any of his Subcontractors or Sub-subcontractors; and

3. other property at the site or adjacent thereto, roadways, structures, and utilities not designated for removal, relocation or replacement in the course of construction.

12.2.2. When the use of storage for explosive or other hazardous materials or equipment is necessary for the execution of the Work, the Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.

12.2.3. All damage or loss to any property referred to in Clauses 2 and 3 of Paragraph 12.2.1 hereof, caused in whole or in part by the Contractor, any Subcontractor or Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable, shall be remedied by the Contractor, except damage or loss attributable to faulty Drawings or Specifications or to the acts or omissions of the Owner or Architect or anyone employed by either of them or for whose acts either of them may be liable, and not attributable to any fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to his obligations under Paragraph 4.17.

12.2.4. The Contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated in writing by the Contractor to the Owner and the Architect.

12.2.5. The Contractor shall not load or permit any part of the work to be loaded so as to endanger its safety.

12.3 EMERGENCIES

12.3.1. In any emergency affecting the safety of persons or property, the Contractor shall act, at his discretion, to prevent threatened damage, injury or loss. Any additional compensation or extension of time claimed by the Contractor on account of emergency work shall be determined as provided in Article XIII hereof for Changes in the Work.

ARTICLE XIII – CHANGES IN THE WORK

13.1 CHANGE ORDERS

13.1.1. Without invalidating the Contract, the Owner may order Changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and the Contract Time being adjusted accordingly. All such Changes in the Work shall be authorized by Change Order, and shall be performed under the applicable conditions of the Contract Documents.

13.1.2. A Change Order is a written order to the Contractor signed by the Owner and the Architect, and approved in writing by an Authorized Officer of the Authority, issued after the execution of the Contract authorizing a Change in the Work or an adjustment in the Total Contract Sum or the Contract Time. The Total Contract Sum and the Contract Time may be changed only by Change Order.

13.1.3. The cost or credit to the Owner resulting from a Change in the Work shall be determined in one or more of the following ways:

1. by mutual acceptance of a lump sum properly itemized, and supported by sufficient substantiating data to permit evaluation;

2. by unit prices stated in the Contract Documents or subsequently agreed upon; or

3. by cost and a mutually acceptable fixed or percentage fee.

13.1.4. If none of the methods set forth in Paragraph 13.1.3 hereof are appropriate because of the unusual nature of the Change in the Work, the Contractor, provided he receives a Change Order, shall proceed promptly with the Work involved. The cost of such Work shall then be determined by the Architect with the written approval of an Authorized Officer of the Authority, on the basis of the Contractor's reasonable expenditures and savings, including, in the case of an increase in the Total Contract Sum, a reasonable allowance for overhead and profit. In such case, and also under Clause 3 of Paragraph 13.1.3 hereof, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, cost shall be limited to the following: cost of materials, including sales tax and cost of delivery; cost of labor, including social security, old age and unemployment insurance, and fringe benefits required by agreement or custom; workers' or workmen's compensation insurance; bond premiums; rental value of equipment and machinery; and the additional costs of supervision and field office personnel directly attributable to the change. Pending final determination of cost to the Owner, payments on account shall be made on the Architect's Certificate for Payment. The amount of credit to be allowed by the Contractor to the Owner for any deletion of change which results in a net decrease in cost will be the amount of the actual net decrease as confirmed by the Architect. When both additions and credits are involved in any one change, the allowance for overhead and profit shall be figured on the basis of net increase, if any.

13.1.5. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if the quantities originally contemplated are so changed in a proposed Change Order that application of the agreed unit prices to the quantities of Work proposed will create a hardship on the Owner or the Contractor, the applicable unit prices shall be equitably adjusted to prevent such hardship.

13.1.6. If the Contractor claims that additional cost or time is involved because of (1) any written interpretation issued pursuant to Paragraph 1.2.4 hereof, (2) any order by the Architect to stop the work pursuant to Paragraph 2.2.10 hereof where the Contractor was not at fault, or (3) any written order for a minor change in the Work issued pursuant to Paragraph 13.3.1 hereof, the Contractor shall make such claim as provided in Section 13.2 hereof.

13.2 CLAIMS FOR ADDITIONAL COST OR TIME

13.2.1. If the Contractor wishes to make a claim for an increase in the Total Contract Sum or an extension in the Contract Time, he shall give the Architect and the Authority written notice thereof within five (5) days after the occurrence of the event giving rise to such claim. Any notice for an increase in the Total Contract Sum shall have a caption at the top of the first page, in capital letters, as follows: "NOTICE OF CLAIM FOR INCREASE IN TOTAL CONTRACT SUM". Claims for extension of the Contract Time shall be made as provided in Paragraph 9.3.2 hereof. This notice shall be given by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property, in which case the Contractor shall proceed in accordance with Paragraph 12.3.1 hereof. No such claim shall be

valid unless so made. If the Owner and the Contractor cannot agree on the amount of the adjustment in the Total Contract Sum or the Contract Time, it shall be determined by the Architect with the written approval of an Authorized Officer of the Authority. Any change in the Total Contract Sum or Contract Time resulting from such claim shall be authorized by Change Order. Notwithstanding any language in the Contract Documents to the contrary, it is expressly provided that the issuance of a written approval signed by an Authorized Officer of the Authority is a condition precedent to any payment for extra work, and proceeding upon oral orders is a waiver by the Contractor of any claim for compensation for any extra work done without such prior written approval.

13.3. MINOR CHANGES IN THE WORK

13.3.1. The Architect shall have authority to order minor changes in the Work not involving an adjustment in the Total Contract Sum or an extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes may be effected by Field Order. Such changes shall be binding on the Owner and the Contractor.

13.4 FIELD ORDERS

13.4.1. The Architect may issue written Field Orders which interpret the Contract Documents in accordance with Paragraph 1.2.4 hereof or which order minor changes in the Work in accordance with Section 13.3 hereof without change in the Total Contract Sum or Contract Time. The Contractor shall carry out such Field Orders promptly.

ARTICLE XIV – UNCOVERING AND CORRECTION OF WORK

14.1 UNCOVERING OF WORK

14.1.1. If any portion of the Work should be covered contrary to the request of the Architect or an Authorized Officer of the Authority, it must, if required by the Architect or an Authorized Officer of the Authority, be uncovered for observation and replaced, at the Contractor's expense.

14.1.2. If any other work has been covered which the Architect or an Authorized Officer of the Authority has not specifically requested to observe prior to being covered, the Architect or an Authorized Officer of the Authority may request to see such Work and it shall be uncovered by the Contractor. If such Work be found in accordance with the Contract Documents, the cost of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work be found not in accordance with the Contract Documents, the Contractor shall pay such costs unless it be found that this condition was caused by a separate contractor employed as provided in Article VI hereof, and in that event the Owner shall be responsible for the payment of such costs.

14.2 CORRECTION OF WORK

14.2.1. The Contractor shall promptly correct all Work rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after Final Completion and whether or not fabricated, installed, or completed. The Contractor shall bear all costs of correcting such rejected Work, including the cost of the Architect's additional services thereby made necessary.

14.2.2. If, within one year after the Date of Final Payment or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by

the Contract Documents, any of the Work is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly after the receipt of a written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition and acceptance of such condition has been approved in writing by an Authorized Officer of the Authority. This obligation shall survive termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.

14.2.3. If the Contractor fails to correct such defective or non-conforming Work, the Owner may correct it in accordance with Section 8.4 hereof.

14.2.4. The Contractor shall bear the cost of making good all work of separate contractors destroyed or damaged by such removal or correction.

14.2.5. The Contractor shall remove from the site all portions of the Work which are defective or non-conforming and which have not been corrected under Subparagraphs 4.5.1, 14.2.1, and 14.2.2, unless removal is waived by the Owner.

14.2.6. If the Contractor does not remove such defective or non-conforming Work within a reasonable time fixed by written notice from the Architect, the Owner may remove it and may store the material or equipment at the expense of the Contractor. If the Contractor does not pay the cost of such removal and storage within ten (10) days thereafter, the Owner may, upon ten (10) additional days written notice, sell such Work at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs that should have been borne by the Contractor including compensation for additional architectural services. If such proceeds of sale do not cover all costs which the Contractor should have borne, the difference shall be charged to the Contractor and an appropriate Change Order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

14.2.7. Nothing contained in this Paragraph 14.2 shall be construed to establish a period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents, including Paragraph 14.5 hereof. The establishment of the time period of one year after the Date of Final Payment or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents relates only to the specific obligation of the Contractor to correct the Work and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the Work.

14.3 ACCEPTANCE OF DEFECTIVE OR NON-CONFORMING WORK

14.3.1. If the Owner prefers to accept defective or non-conforming Work, he may do so after receiving written approval therefore from an Authorized Officer of the Authority instead of requiring its removal and correction, in which case a Change Order will be issued to reflect a reduction in the Contract Sum where appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE XV – ARBITRATION

15.1 ARBITRATION

15.1.1. All disputes, claims, or questions with respect to the proper performance of the Work shall be submitted to the Authority and the decision of an Authorized Officer of the Authority shall be final and binding upon the Owner and the Contractor.

15.1.2. All disputes, claims, or questions between the Owner and the Contractor on matters other than the proper performance of the Work may be submitted to arbitration in accordance with the Rules of the American Arbitration Association. The decision pursuant to any arbitration shall be binding upon the parties hereto if accepted by an Authorized Officer of the Authority in writing. The cost of such arbitration shall be borne equally by the Owner and the Contractor and such expenses incurred by the Contractor shall not be subject to reimbursement.

END OF SECTION
MSHDA GENERAL CONDITIONS

for Homes

LEED for Homes Project Checklist

Builder Name:	*Dwelling Place*
Project Team Leader:	*Brian Winkelman*
Home Address (Street/City/State):	*323 S. Division, Grand Rapids, Michigan*

Project Description

Building Type: *Multi-family*
# of Units: *55*
Project type: *Multi-family Developer*
Avg. Home Size Adjustment: *-10*

Adjusted Certification Thresholds

Certified: *35.0* Gold: *65.0*
Silver: *50.0* Platinum: *80.0*

Project Point Total
Prelim: *77 + 1 maybe pts* Final: *29*

Certification Level
Prelim: *Gold* Final: *Not Certified*

Final Credit Category Point Totals
ID: 0 *SS: 13* *EA: 13* *EQ: 0*
LL: 0 *WE: 0* *MR: 3* *AE: 0*
Minimum Point Thresholds Not Met for Final Rating

Date Most Recently Updated: *19-Jul-12* *Updated by:* *Michael Holcomb*

Indicates that an Accountability Form is required.

	Max Pts. Available	Preliminary Rating Y / Pts	Maybe	No	Notes	Project Points
Innovation & Design Process (ID) (Minimum 0 ID Points Required)	*Max: 11*	*Y: 4*	*M: 0*			*Final: 0*
1. Integrated Project Planning						
1.1 Preliminary Rating	*Prereq.*	Y				
Target performance tier: *Silver*						
1.2 Integrated Project Team *(meet all of the following)*	1	1	0			0
☑ a) Individuals or organizations with necessary capabilities		☑ c) Regular meetings held with project team				
☑ b) All team members involved in various project phases						
1.3 Professional Credentialed with Respect to LEED for Homes	1	0	0		*please see ID 01-06 for details*	0
1.4 Design Charrette	1	1	0			0
1.5 Building Orientation for Solar Design *(meet all of the following)*	1	0	0			0
☐ a) Glazing area on north/south walls 50% greater than on east/west walls		☐ c) At least 450 sq. ft. of south-facing roof area, oriented for solar applications				
☐ b) East-west axis is within 15 degrees of due east-west		☐ d) 90% of south-facing glazing is shaded in summer, unshaded in winter				
2. Quality Management for Durability						
2.1 Durability Planning *(meet all of the following)*	*Prereq.*	Y				
☑ a) Durability evaluation completed		☑ d) Durability strategies incorporated into project documentation				
☑ b) Strategies developed to address durability issues		☑ e) Durability measures listed in durability inspection checklist				
☑ c) Moisture control measures from Table 1 incorporated						
2.2 Durability Management *(meet one of the following)*	*Prereq.*					
☐ Builder has a quality management process in place		☐ Builder conducted inspection using durability inspection checklist				
2.3 Third-Party Durability Management Verification	3	0	0			0

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3. Innovative or Regional Design						
3.1 Innovation 1 (ruling #):	SS 6 Exemplary Performance	1	1	0		0
3.2 Innovation 2 (ruling #):	MR 2.2 Exemplary Performance	1	1	0		0
3.3 Innovation 3 (ruling #):		1	0	0		0
3.4 Innovation 4 (ruling #):		1	0	0		0
Location & Linkages (LL) (Minimum 0 LL Points Required)		**Max: 10**	**Y:10**	**M:0**	**Notes**	**Final: 0**
1. LEED for Neighborhood Development						
1 LEED for Neighborhood Development		10	0	0		0
2. Site Selection						
2 Site Selection *(meet all of the following)*		2	2	0		0
☑ a) Built above 100-year floodplain defined by FEMA		☑ d) Not built on land that was public parkland prior to acquisition				
☑ b) Not built on habitat for threatened or endangered species		☑ e) Not built on land with prime soils, unique soils, or soils of state significance				
☑ c) Not built within 100 ft of water, including wetlands						
3. Preferred Locations						
3.1 Edge Development		1	0	0		0
OR 3.2 Infill		2	2	0		0
AND/OR 3.3 Previously Developed		1	1	0		0
4. Infrastructure						
4 Existing Infrastructure		1	1	0		0
5. Community Resources / Transit						
5.1 Basic Community Resources / Transit *(meet one of the following)*		1	0	0		0
☐ a) Within 1/4 mile of 4 basic community resources		☐ c) Within 1/2 mile of transit services providing 30 rides per weekday				
☐ b) Within 1/2 mile of 7 basic community resources						
OR 5.2 Extensive Community Resources / Transit *(meet one of the following)*		2	0	0		0
☐ a) Within 1/4 mile of 7 basic community resources		☐ c) Within 1/2 mile of transit services providing 60 rides per weekday				
☐ b) Within 1/2 mile of 11 basic community resources						
OR 5.3 Outstanding Community Resources / Transit *(meet one of the following)*		3	3	0		0
☐ a) Within 1/4 mile of 11 basic community resources		☑ c) Within 1/2 mile of transit services providing 125 rides per weekday				
☐ b) Within 1/2 mile of 14 basic community resources						
6. Access to Open Space						
6 Access to Open Space		1	1	0	Heartside park	0

Sustainable Sites (SS) (Minimum 5 SS Points Required)	Max: 22	Y:17	M:1	Notes	Final: 13
1. Site Stewardship					
1.1 Erosion Controls During Construction *(meet all of the following)*	Prereq.	Y			
☑ a) Stockpile and protect disturbed topsoil from erosion.		☑ d) Provide swales to divert surface water from hillsides			
☑ b) Control the path and velocity of runoff with silt fencing or equivalent.		☑ e) Use tiers, erosion blankets, compost blankets, etc. on sloped areas.			
☑ c) Protect sewer inlets, streams, and lakes with straw bales, silt fencing, etc.					
1.2 Minimize Disturbed Area of Site *(meet the appropriate requirements)*	1	1	0		0
Where the site is not previously developed, meet all the following:					
☐ a) Develop tree / plant preservation plan with "no-disturbance" zones					
☐ b) Leave 40% of buildable lot area, not including area under roof, undisturbed					
OR Where the site is previously developed, meet all the following:					
☐ c) Develop tree / plant preservation plan with "no-disturbance" zones AND					
☐ Rehabilitate lot; undo soil compaction and remove invasive plants AND					
☐ Meet the requirements of SS 2.2					
OR ☑ d) Build on a lot of 1/7 acre or less, or 7 units per acre.					
2. Landscaping					
2.1 ✍ No Invasive Plants	Prereq.	Y			
2.2 ✍ Basic Landscaping Design *(meet all of the following)*	2	2	0		0
☑ a) Any turf must be drought-tolerant.		☑ d) Add mulch or soil amendments as appropriate.			
☑ b) Do not use turf in densely shaded areas.		☑ e) All compacted soil must be tilled to at least 6 inches.			
☑ c) Do not use turf in areas with slope of 25%					
AND/OR 2.3 ✍ Limit Conventional Turf	3	3	0		3
0% Percentage of designed landscape softscape area that is turf					
AND/OR 2.4 ✍ Drought-Tolerant Plants	2	2	0		2
100% Percentage of installed plants that are drought-tolerant					
OR 2.5 ✍ Reduce Overall Irrigation Demand by at Least 20%	6	0	0		0
☐ Percentage reduction in estimated irrigation water demand	*(calculate)*				
3. Reduce Local Heat Island Effects					
3 ✍ Reduce Local Heat Island Effects *(meet one of the following)*	1	0	0		0
☐ a) Locate trees / plantings to provide shade for 50% of hardscapes		☐ b) Install light-colored, high-albedo materials for 50% of sidewalks, patios, and driveways			

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4. Surface Water Management

4.1	≤ Permeable Lot	4	4	0	4

[100%] vegetative landscape

[ ] permeable paving

[ ] impermeable surfaces directed to infiltration features

[0%] other impermeable surfaces (areas not counted towards credit)

4.2	Permanent Erosion Controls *(meet one of the following)*	1	0	1	0

☐ a) For portions of lot on steep slope, use terracing and retaining walls

☑ b) Plant trees, shrubs, or groundcover

4.3	≤ Management of Runoff from Roof *(meet any, see Rating System for pts)*	2	0	0	0

☐ a) Install permanent stormwater controls to manage runoff from the home

☐ b) Install vegetated roof to cover 50% of roof area

☐ c) Install vegetated roof to cover 100% of roof area

☐ d) Have lot designed by professional to manage runoff from home on-site

5. Nontoxic Pest Control

5	Pest Control Alternatives *(meet any of the following, 1/2 pt each)*	2	1	0	0

☑ a) Keep all exterior wood at least 12" above soil

☐ b) Seal external cracks, joints, etc. with caulking and install pest-proof screens

☑ c) Include no wood-to-concrete connections, or separate connections with dividers

☐ d) Install landscaping so mature plants are 24" from home

e) In 'moderate' to 'very heavy' termite risk areas:

☐ i) Treat all cellulosic material with borate product to 3' above foundation

☐ ii) Install sand or diatomaceous earth barrier

☐ iii) Install steel mesh barrier termite control system

☐ iv) Install non-toxic termite bait system

☐ v) Use noncellulosic wall structure

☐ vi) Use solid concrete foundation walls or pest-proof masonry wall design

6. Compact Development

6.1	Moderate Density	2	0	0	0

[55] # of total units on the lot [0.7] lot size (acres) [82.1] density (units/acre)

OR 6.2	High Density	3	0	0	0
OR 6.3	Very High Density	4	4	0	4

Water Efficiency (WE) (Minimum 3 WE Points Required)

Max: 15 Y:6 M:0 ***Notes*** ***Final: 0***

1. Water Reuse

1.1	Rainwater Harvesting System	4	0	0	0

[ ] Percentage of roof area used for harvesting

[ ] Application

AND/OR 1.2	Graywater Reuse System	1	0	0	0
OR 1.3	Use of Municipal Recycled Water System	3	0	0	0

2. Irrigation System

2.1 ☑ High-Efficiency Irrigation System *(meet any of the following, 1 pt each)* — 3 | 0 | 0 | 0

- ☐ a) Irrigation system designed by EPA Water Sense certified professional
- ☐ b) Irrigation system with head-to-head coverage
- ☐ c) Install central shut-off valve
- ☐ d) Install submeter for the irrigation system
- ☐ e) Use drip irrigation for 50% of planting beds
- ☐ f) Create separate zones for each type of bedding
- ☐ g) Install timer or controller for each watering zone
- ☐ h) Install pressure-regulating devices
- ☐ i) High-efficiency nozzles with distribution uniformity of at least 0.70.
- ☐ j) Install check valves in heads
- ☐ k) Install moisture sensor or rain delay controller

AND/OR 2.2 Third-party inspection — 1 | 0 | 0 | 0

OR 2.3 ☑ Reduce Overall Irrigation Demand by at Least 45% — 4 | 0 | 0 | 0

☐ Percentage reduction in estimated irrigation water demand *(calculate)*

3. Indoor Water Use

3.1 High-Efficiency Fixtures and Fittings *(meet any of the following, 1 pt each)* — 3 | 0 | 0 | 0

- ☐ a) Average flow rate of lavatory faucets is ≤ 2.00 gpm
- ☐ b) Average flow rate for all showers is ≤ 2.00 gpm per stall
- ☐ c) Average flow rate for all toilets is ≤ 1.30 gpf; OR
  ☐ Toilets are dual-flush; OR
  ☐ Toilets meet the EPA Water Sense specification

3.2 Very High-Efficiency Fixtures and Fittings *(meet any, 2 pts each)* — 6 | 6 | 0 | 0

- ☑ a) Average flow rate of lavatory faucets is ≤ 1.50 gpm; OR
  ☐ Lavatory faucets meet the EPA Water Sense specification
- ☑ b) Average flow rate for all showers ≤ 1.75 gpm per stall
- ☑ c) Average flow rate for all toilets is ≤ 1.10 gpf

Energy & Atmosphere (EA) (Minimum 0 EA Points Required) — Max: 38 Y:13 M:0 — Notes — Final: 13

1. Optimize Energy Performance

1.1 Performance of ENERGY STAR for Homes — Prereq. | Y

1.2 Exceptional Energy Performance — 34 | 13 | 0 | 13

5 IECC climate zone 70 HERS Index

7. Water Heating

7.1 ☑ Efficient Hot Water Distribution System *(meet one of the following)* — 2 | 0 | 0 | 0

- ☐ a) Structured plumbing system
- ☐ b) Central manifold distribution system
- ☐ c) Compact design of conventional system

7.2 Pipe Insulation — 1 | 0 | 0 | 0

11. Residential Refrigerant Management

11.1 Refrigerant Charge Test — Prereq. | Y | Exempt Factory Charged (not split)

11.2 Appropriate HVAC Refrigerants *(meet one of the following)* — 1 | 0 | 0 | 410A | 0

- ☐ a) Use no refrigerants
- ☑ b) Use non-HCFC refrigerants
- ☐ c) Use refrigerants that complies with global warming potential equation

Materials & Resources (MR) (Minimum 2 MR Points Required) — Max: 16 Y:13 M:0 — Notes — Final: 3

1. Material-Efficient Framing

		Prereq.	Y			
1.1	Framing Order Waste Factor					
1.2	Detailed Framing Documents	1	1	0		0
AND/OR 1.3	Detailed Cut List and Lumber Order	1	1	0	ReUse	0

☐ Requirements of MR 1.2 have been met ☐ Detailed cut list and lumber order corresponding to framing plans or scopes

AND/OR 1.4	Framing Efficiencies *(meet any of the following, see Rating System for pts)*	3	0	0	0

☐ Precut framing packages
☐ Open-web floor trusses
☐ Structural insulated panel walls
☐ Structural insulated panel roof
☐ Structural insulated panel floors
☐ Stud spacing greater than 16" on center
☐ Ceiling joist spacing greater than 16" on center
☐ Floor joist spacing greater than 16" on center
☐ Roof rafter spacing greater than 16" on center
☐ Two of the following: Size headers for loads; ladder blocking; drywall clips; 2-stud corners

OR 1.5	Off-site Fabrication *(meet one of the following)*	4	0	0	0

☐ a) Panelized construction ☐ b) Modular, prefabricated construction

2. Environmentally Preferable Products

		Prereq.	Y			
2.1	FSC Certified Tropical Wood *(meet all of the following)*					

☐ a) Provide suppliers with a notice of preference for FSC products; AND ☐ b) No tropical wood installed (exceptions for FSC-certified or reclaimed wood)
☐ Request country of manufacture for each wood product

2.2	Environmentally Preferable Products *(meet any, 1/2 pt each)*	8	8	0	0

Assembly : component	(a) EPP			(b) Low emission		(c) Local production	
Exterior wall: framing	☑		type: Reuse			☑	
Exterior wall: siding or masonry	☑		type: Reuse			☑	
Floor: flooring	☐	(45%)	type:	☐	90% hard flooring	☐	(45%)
Floor: flooring	☐	(90%)	type:	☐	SCS FloorScore	☐	(90%)
Floor: flooring				☑	Green Label Plus		
Floor: framing	☐		type:			☐	
Foundation: aggregate	☑		type: Reuse			☑	
Foundation: cement	☑		type: Reuse			☑	
Interior wall: framing	☑		type: Reuse			☑	
Interior wall, ceiling: gypsum board	☐		type:			☑	
Interior wall, ceiling, millwork: paint	☐		type:	☑	type: Zero VOC	☐	
Landscape: decking and patio	☐		type:			☐	
Other: cabinet	☐		type:			☐	
Other: counter	☐		type:			☐	
Other: door	☐		type:			☐	
Other : interior trim	☐		type:			☐	
Other: adhesive, sealant				☑	type: Low VOC		
Other : window frame	☐		type:			☐	
Roof: framing	☑		type: Reuse			☑	
Roof: roofing	☐		type:			☐	
Roof, floor, wall: cavity insulation	☐		type:	☐	type:	☑	
Roof, floor, wall (2 of 3): sheathing	☑		type: Reuse			☐	
Other: water supply piping	☐		type:				
Other: driveway	☐		type:				

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3. Waste Management

3.1 Construction Waste Management Planning *(meet both of the following)* — Prereq. Y

☑ a) Investigate local options for waste diversion ☑ b) Document diversion rate for construction waste

3.2 Construction Waste Reduction *(use one of the following methods)* — 3 | 3 | 0 | 3

0.5 a) pounds waste / square foot

☐ cubic yards waste / 1,000 square feet

☐ b) percentage of waste diverted

Indoor Environmental Quality (EQ) (Minimum 6 EQ Points Required) — Max: 21 Y:13 M:0 — Notes — Final: 0

1. ENERGY STAR with Indoor Air Package

1 ENERGY STAR with Indoor Air Package — 13 | 0 | 0 | 0

2. Combustion Venting

2.1 Basic Combustion Venting Measures (meet all of the following) — Prereq. Y

☑ a) no unvented combustion appliances

☑ b) carbon monoxide monitors on each floor (of each unit, if applicable)

☑ c) no fireplace installed, OR

☐ all fireplaces and woodstoves have doors

☑ d) space, water heating equipment designed with closed combustion; OR

☐ space and water heating equipment has power-vented exhaust; OR

☐ space and water heating equipment located in detached or open-air facility; OR

☐ no space- or water-heating equipment with combustion

2.2 Enhanced Combustion Venting Measures (meet one of the following) — 2 | 2 | 0 | 0

Type of Fireplace or stove	*Better practice (1 pt)*	*Best practice (2 pts) (must also meet Better Practice)*
None		☑ granted automatically
Masonry wood-burning fireplace	☐ masonry heater	☐ back-draft potential test
Factory-built wood-burning fireplace	☐ listed by testing lab and meets EPA standards	☐ back-draft potential test
Woodstove and fireplace insert	☐ listed by testing lab and meets EPA standards	☐ back-draft potential test
Natural gas, propane, or alcohol stove	☐ listed, power- or direct-vented, fixed doors	☐ electronic pilot
Pellet stove	☐ EPA certified or meets safety requirements	☐ power- or direct-venting

3. Moisture Control

3 Moisture Load Control (meet one of the following) — 1 | 0 | 0 | 0

☐ a) Additional dehumidification system ☐ b) Central HVAC system equipped with additional dehumidification mode

4. Outdoor Air Ventilation

4.1 Basic Outdoor Air Ventilation (meet one of the following) — Prereq. Y

☐ a) Qualifies under ASHRAE Std. 62.2-2007 climate exemption.

☑ b) Continuous ventilation

☐ c) Intermittent ventilation

☐ d) Passive ventilation

4.2 Enhanced Outdoor Air Ventilation *(meet one of the following)* — 2 | 2 | 0 | 0

☐ a) Meets EQ 4.1 part (a), active ventilation system installed ☑ b) Install heat recovery system

4.3 Third-Party Performance Testing — 1 | 0 | 0 | 0

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5. Local Exhaust

5.1	Basic Local Exhaust (meet all of the following)	Prereq.	Y		
	☑ a) Bathroom and kitchen exhaust meets ASHRAE Std. 62.2 air flow requirement		☑ c) Air exhausted to outdoors		
	☑ b) Fans and ducts designed and installed to ASHRAE Std. 62.2		☑ d) ENERGY STAR labeled bathroom exhaust fans		
5.2	Enhanced Local Exhaust *(meet one of the following)*	1	1	0	0
	☑ a) Occupancy sensor		☐ c) Automatic timer tied to switch to operate fan for 20+ minutes post-occupancy		
	☐ b) Automatic humidistat controller		☐ d) Continuously operating exhaust fan		
5.3	Third-Party Performance Testing	1	0	0	0

6. Distribution of Space Heating and Cooling

6.1	Room-by-Room Load Calculations	Prereq.	Y		
6.2	Return Air Flow / Room-by-Room Controls (meet one of the following)	1	1	0	0
	A. Forced-Air Systems		B. Nonducted HVAC Systems		
	☐ a) Return air opening of 1 sq. inch per cfm of supply		☐ Flow control valves on every radiator; OR		
	☑ b) Limited pressure differential between closed room and adjacent spaces		☐ Radiant floor system with thermostatic controls in every room		
6.3	Third-Party Performance Test / Multiple Zones (meet one of the following)	2	0	0	0
	A. Forced-Air Systems		B. Nonducted HVAC Systems		
	☐ Have supply air flow rates in each room tested and confirmed		☐ Install at least two distinct zones with independent thermostat control		

7. Air Filtering

		Prereq.	Y	MERV 8	
7.1	Good Filters	1	0	0	0
7.2	Better Filters	1	0	0	0
OR 7.3	Best Filters	2	0	0	0

8. Contaminant Control

8.1	Indoor Contaminant Control during Construction	1	1	0	0
8.2	Indoor Contaminant Control *(meet any of the following, 1 pt each)*	2	2	0	0
	☑ a) Design and install permanent walk-off mats at each entry		☐ c) Install central vacuum system with exhaust to outdoors		
	☐ b) Design shoe removal and storage space near primary entryway				
8.3	Preoccupancy Flush	1	1	0	0

9. Radon Protection

9.1	Radon-Resistant Construction in High-Risk Areas	Prereq.	N/A		
9.2	Radon-Resistant Construction in Moderate-Risk Areas	1	0	0	0

10. Garage Pollutant Protection						
	10.1 No HVAC in Garage	Prereq.	Y			
	10.2 Minimize Pollutants from Garage (meet all of the following)	2	0	0		0
	a) In conditioned spaces above garage: ☐ Seal all penetrations and connecting floor and ceiling joist bays	b) In conditioned spaces next to garage ☐ Weather-strip all doors ☐ Carbon monoxide detectors in rooms that share a door with garage ☐ Seal all penetrations and cracks at the base of walls				
AND/OR	10.3 Exhaust Fan in Garage (meet one of the following)	1	0	0		0
	☐ a) Fan runs continuously	☐ b) Fan designed with automatic timer control				
OR	10.4 Detached Garage or No Garage	3	3	0	*No garage*	0

Awareness & Education (AE) (Minimum 0 AE Points Required)	**Max: 3**	**Y:1**	**M:0**	**Notes**	**Final: 0**
1. Education of the Homeowner or Tenant					
1.1 ✍ Basic Operations Training *(meet both of the following)*	Prereq.	Y			
☑ a) Operations and training manual	☑ b) One-hour walkthrough with occupant(s)				
1.2 ✍ Enhanced Training	1	0	0		0
1.3 Public Awareness *(meet three of the following)*	1	0	0		0
☐ a) Open house on at least four weekends	☑ c) Newspaper article on the project				
☑ b) Website about features and benefits of LEED homes	☑ d) Display LEED signage on the exterior of the home				
2. Education of the Building Manager					
2 ✍ Education of the Building Manager *(meet both of the following)*	1	1	0		0
☑ a) Operations and training manual	☑ b) One-hour walkthrough with building manager				

USGBC LEGAL DISCLAIMER

USGBC makes no warranty with respect to any LEED certified project, including any warranty of habitability, merchantability, or fitness for a particular purpose. There are no warranties, express or implied, written or oral, statutory or otherwise, with respect to the certifications provided by USGBC. By way of example only, and without limiting the broad scope of the foregoing, it is understood that LEED certification, whether at the Certified level or any other level, does not mean that the project is structurally sound or safe, constructed in accordance with applicable laws, regulations or codes, free of mold or mildew, free of volatile organic compounds or allegens, or free of soil gases including radon.

SIGNATURES BY RESPONSIBLE PARTIES

By affixing my signature below, the undersigned does hereby declare and affirm to the USGBC that the LEED for Homes requirements, as specified in the LEED for Homes Rating System, have been met for the indicated credits and will, if audited, provide the necessary supporting documents.

Project Team Leader	***Brian Winkelman***	Company	
Signature		Date	

By affixing my signature below, the undersigned does hereby declare and affirm to the USGBC that the required inspections and performance testing for the LEED for Homes requirements, as specified in the LEED for Homes Rating System, have been completed. I have evaluated this project's documentation package and conducted the necessary QA/QC procedures with the Green Rater, and I hereby declare and affirm to USGBC that the homes included in this submittal are ready to earn LEED for Homes certification, as per the attached checklist.

Provider QAD	***Jason LaFleur***	Company	***AES***
Signature		Date	

By affixing my signature below, the undersigned does hereby declare and affirm to the USGBC that the required inspections and performance testing for the LEED for Homes requirements, as specified in the LEED for Homes Rating System, have been completed.

I also hereby confirm that all verification services were performed in accordance with the LEED for Homes Verification & Submittal Guidelines and Addendum.

Green Rater	***Michael Holcomb***	Company	***Home Inspector General***
Signature		Date	

By affixing my signature below, the undersigned does hereby declare and affirm to the USGBC that the required inspections and performance testing for the LEED for Homes requirements, as specified in the LEED for Homes Rating System, have been completed.

I also hereby confirm that all verification services were performed in accordance with the LEED for Homes Verification & Submittal Guidelines and Addendum.

Green Rater		Company	
Signature		Date	

LEED for Homes Project Checklist

Addendum: Prescriptive Approach for Energy and Atmosphere (EA) Credits

Points cannot be earned in both the Prescriptive (below) and the Performance paths of the EA section.

		Max Pts. Available	Preliminary Rating Y / Pts	Maybe	No	Notes	Project Points
Energy & Atmosphere (EA) (Minimum 0 EA Points Required)		**Max: 38**	**Y:13**	**M:0**		**Notes**	**Final: 13**
2. Insulation							
2.1	Basic Insulation *(meet both of the following)*	Prereq.					
	☐ a) Insulation meets R-value requirements of IECC		☐ b) Insulation meets HERS Grade II specifications for installation				
2.2	Enhanced Insulation *(meet both of the following)*	2	0	0			0
	☐ a) Insulation exceeds R-value requirements of IECC by 5%		☐ b) Insulation meets HERS Grade I specifications for installation				
3. Air Infiltration							
3.1	Reduced Envelope Leakage	Prereq.					
	☐ Air leakage rate in ACH50						
3.2	Greatly Reduced Envelope Leakage	2	0	0			0
OR 3.3	Minimal Envelope Leakage	3	0	0			0
4. Windows							
4.1	Good Windows *(meet all of the following)*	Prereq.					
	☐ a) Windows and glass doors meet ENERGY STAR BOP window specifications		☐ b) Skylight glazing area is ≤ 3% of floor area AND ☐ Skylights meet ENERGY STAR requirements for skylights				
4.2	Enhanced Windows	2	0	0			0
OR 4.3	Exceptional Windows	3	0	0			0
5. Heating and Cooling Distribution System							
5.1	Reduced Distribution Losses *(meet all of the following, as appropriate)*	Prereq.					
	A. Forced-Air Systems		B. Nonducted HVAC Systems				
	☐ a) Duct leakage of ≤ 4.0 CFM at 25 Pascals per 100 sq.ft.		☐ At least R-3 insulation around pipes in unconditioned spaces				
	☐ b) No ducts in exterior walls unless extra insulation is added						
	☐ c) At least R-6 insulation around ducts in unconditioned spaces						
5.2	Greatly Reduced Distribution Losses *(meet the following, as appropriate)*	2	0	0			0
	A. Forced-Air Systems		B. Nonducted HVAC Systems				
	☐ Duct leakage of ≤ 3.0 CFM at 25 Pascals per 100 sq.ft.		☐ Keep the boiler and pipes entirely within conditioned envelope				
OR 5.3	Minimal Distribution Losses *(meet one of the following, as appropriate)*	3	0	0			0
	A. Forced-Air Systems		B. Nonducted HVAC Systems				
	☐ a) Duct leakage of ≤ 1.0 CFM at 25 Pascals per 100 sq.ft.		☐ Outdoor reset control to set distribution temp. based on outdoor temp.				
	☐ b) Air-handler and all ductwork is within conditioned envelope and EA 3.3 is met						
	☐ c) Air-handler and all ductwork visibly within conditioned spaces (not in walls, etc.)						

6. Space Heating and Cooling Equipment

6.1	✍ Good HVAC Design and Installation *(meet all of the following)*	Prereq.				
	☐ a) Design and size HVAC equipment using ACCA Manual J or equivalent				☐ c) Install ENERGY STAR programmable thermostat OR	
	☐ b) Install efficient heating AND cooling equipment (see Table)				☐ Heat pump or hydronic installed and exempted from part (c)	
	☐ Type of cooling system				☐ Type of heating system	
	☐ Cooling efficiency (SEER / EER)				☐ Heating Efficiency (AFUE / HSPF / COP)	
6.2	High-Efficiency HVAC	2	0	0		0
OR 6.3	Very High Efficiency HVAC	4	0	0		0

7. Water Heating

7.1	✍ Efficient Hot Water Distribution System *(meet one of the following)*	2	0	0		0
	☐ a) Structured plumbing system				☐ c) Compact design of conventional system	
	☐ b) Central manifold distribution system					
7.2	Pipe Insulation	1	0	0		0
7.3	Efficient Domestic Hot Water Equipment	3	0	0		0
	☐ Type of DHW system					
	☐ Efficiency	☐ Solar: Percentage of annual DHW load				

8. Lighting

8.1	ENERGY STAR Lights	Prereq.				
8.2	Improved Lighting *(meet one of the following, see Rating System for pts)*	1.5	0	0		0
	☐ a) Indoor lighting - 3 additional ENERGY STAR lights in high-use rooms				☐ b) Exterior lighting - motion sensor controls or integrated PV	
OR 8.3	Advanced Lighting Package *(meet one of the following)*	3	0	0		0
	☐ a) 60% of fixtures are ENERGY STAR fixtures				☐ b) 80% of lamps are ENERGY STAR CFLs	

9. Appliances

9.1	High-Efficiency Appliances *(meet any, see Rating System for pts)*	2	0	0		0
	☐ a) ENERGY STAR labeled refrigerator				☐ c) ENERGY STAR labeled dishwasher using 6.0 gallons per cycle or less	
	☐ b) ENERGY STAR labeled ceiling fans in living/family room and all bedrooms				☐ d) ENERGY STAR clothes washer	
9.2	Water-Efficiency Clothes Washer	1	0	0		0

10. Renewable Energy

10	✍ Renewable Energy System	10	0	0		0.0
	☐ Reference electric load, kWh/yr (based on HERS model)				☐ Electricity supplied by renewable system, kWh/yr	
	0.0% Percentage of annual reference electric load met by renewable system					

11. Residential Refrigerant Management

11.1	Refrigerant Charge Test	Prereq.				
11.2	Appropriate HVAC Refrigerants *(meet one of the following)*	1	0	0		0
	☐ a) Use no refrigerants				☐ c) Use refrigerants that complies with global warming potential equation	
	☐ b) Use non-HCFC refrigerants					

LEED for Homes Project Checklist, Project Notes

This section was created to give project teams additional space to make internal notes on the progress of the project. It does not need to be used and it **should not** be submitted to USGBC. This section is unlocked, so project teams are welcome to make changes to the format as necessary. Any comments or directions provided below have not been created or endorsed by the US Green Building Council.

Date project began:	
Initiated by:	

Credits	*Responsible Party*	*Last Updated*	*Additional Notes*
ID 1. Integrated Project Planning			
1.1			
1.2			
1.3			
1.4			
1.5			
ID 2. Quality Mgmt for Durability			
2.1			
2.2			
2.3			

3. Innovative or Regional Design				
	3.1			
	3.2			
	3.3			
	3.4			

Credits	Responsible Party	Last Updated	Additional Notes
LL 1. LEED for Neighborhood Development			
1			
LL 2. Site Selection			
2			
LL 3. Preferred Locations			
3.1			
3.2			
3.3			
LL 4. Infrastructure			
4			
LL 5. Community Resources			
5.1			
5.2			
5.3			
LL 6. Access to Open Space			
6			

Credits	Responsible Party	Last Updated	Additional Notes
SS 1. Site Stewardship			
1.1			
1.2			
SS 2. Landscaping			
2.1			
2.2			
2.3			
2.4			
2.5			
SS 3. Reduce Local Heat Island Effects			
3			

Credits	Responsible Party	Last Updated	Additional Notes
SS 4. Surface Water Management			
4.1			
4.2			
4.3			
SS 5. Nontoxic Pest Control			
5			
SS 6. Compact Development			
6.1			
6.2			
6.3			
WE 1. Water Reuse			
1.1			
1.2			
1.3			

Credits	Responsible Party	Last Updated	Additional Notes
WE 2. Irrigation System			
2.1			
2.2			
2.3			
WE 3. Indoor Water Use			
3.1			
3.2			
EA 1. Optimize Energy Performance			
1.1			
1.2			
EA 7. Water Heating			
7.1			
7.2			
EA 11. Residential Refrigerant Management			
11.1			
11.2			

Credits	Responsible Party	Last Updated	Additional Notes
MR 1. Material-Efficient Framing			
1.1			
1.2			
1.3			
1.4			
1.5			
MR 2. Environmentally Preferable Products			
2.1			
2.2			

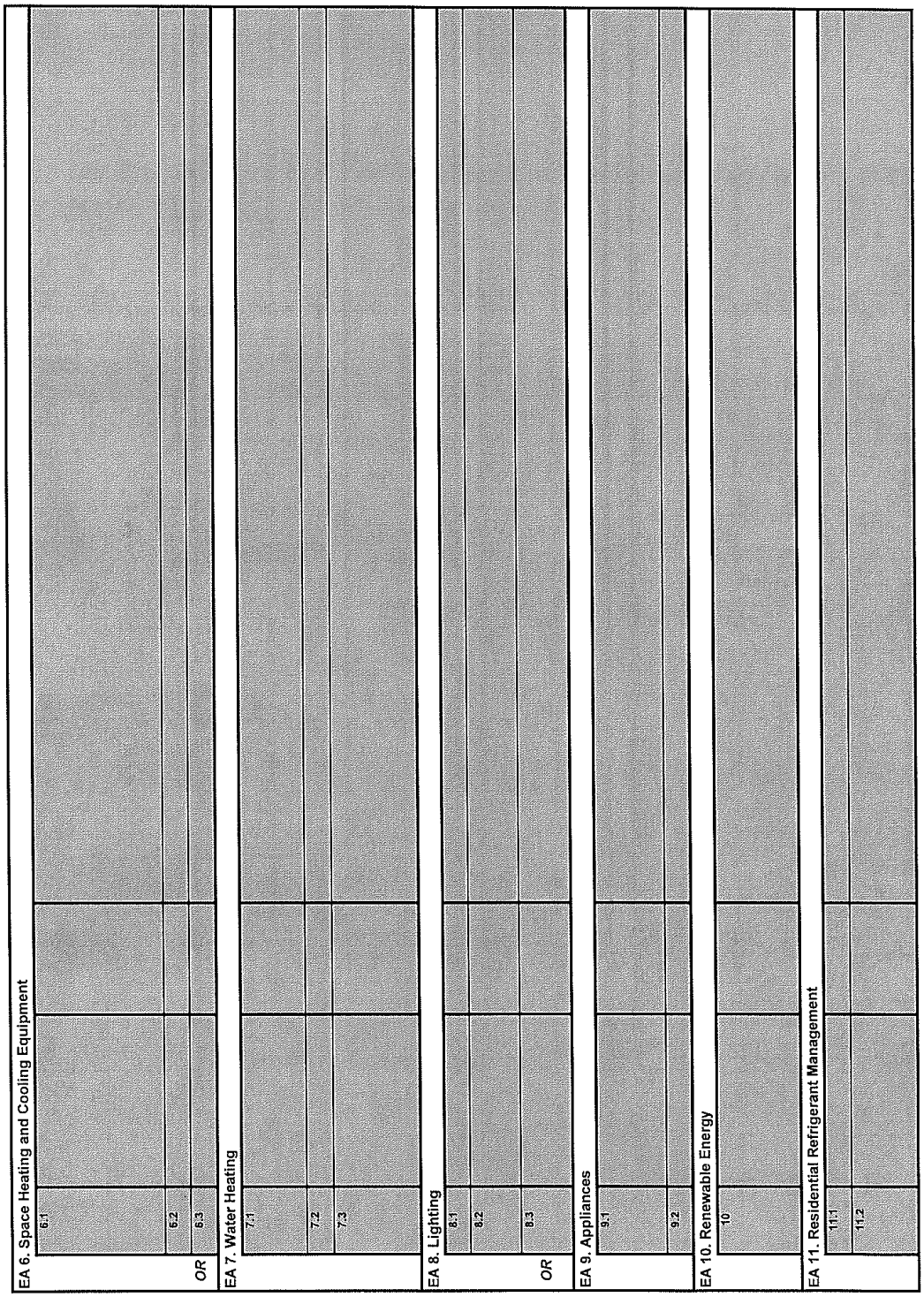
Credits	Responsible Party	Last Updated	Additional Notes
MR 3. Waste Management			
3.1			
3.2			
EQ 1. ENERGY STAR w/ IAP			
1			
EQ 2. Combustion Venting			
2.1			
2.2			
EQ 3. Moisture Control			
3			
EQ 4. Outdoor Air Ventilation			
4.1			
4.2			
4.3			

EQ 5. Local Exhaust					
	5.1				
	5.2				
	5.3				
EQ 6. Distribution of Space Heating and Cooling					
	6.1				
	6.2				
	6.3				
EQ 7. Air Filtering					
	7.1				
	7.2				
	7.3				
EQ 8. Contaminant Control					
	8.1				
	8.2				
	8.3				
EQ 9. Radon Protection					
	9.1				
	9.2				

EQ 10. Garage Pollutant Protection				
10.1				
10.2				
10.3				
10.4				
Credits	*Responsible Party*	*Last Updated*	*Additional Notes*	

AE 1. Education of Home Owner / Tenant				
1.1				
1.2				
1.3				
AE 2. Education of the Building Manager				
2				

Credits
Responsible Party
Last Updated
Additional Notes
EA 2. Insulation
2.1
2.2
EA 3. Air Infiltration
3.1
3.2
OR
3.3
EA 4. Windows
4.1
4.2
OR
4.3
EA 5. Heating and Cooling Distribution
5.1
5.2
5.3
OR



*

END OF SECTION
LEED FOR HOMES

END OF SECTION
LEED FOR HOMES

MICHIGAN SALES and USE TAX EXEMPTION

Michigan Department of Treasury
3520 (Rev. 4-09)

Michigan Sales and Use Tax Contractor Eligibility Statement

A real property contractor may use this form to obtain a statement from the property owner that materials to be affixed to and made a structural part of certain real property qualify for exemption based on facts within the control of the property owner. The property owner should complete the form and return it to the contractor who will submit this form to the supplier along with Michigan's Sales and Use Tax Certificate of Exemption, form 3372 at the time of purchase. Nothing in this statement should be construed to relieve a contractor from tax liability if it is found that the subject property does not qualify for the exemption.

PROPERTY OWNER STATES that materials will be affixed to and made a structural part of its real property and that the property owner is one of the following entities (Check the box that applies):

☐ **Nonprofit Hospital**
Check this box only if the property owner meets the definition of hospitals contained in the Sales and Use Tax Acts MCL 205.54w and 205.94s, respectively.

☒ **Qualified Nonprofit Housing**
Check this box only if the property owner is qualified under section 15a of the state housing development authority act of 1966. (Attach a copy of the Michigan Housing Development Authority ruling.)

☐ **Qualified Water Pollution Control Facility**
(Attach a copy of the exemption certificate granted by the Michigan State Tax Commission.)

☐ **Qualified Air Pollution Control Facility**
(Attach a copy of the exemption certificate granted by the Michigan State Tax Commission.)

☐ **Qualified Convention Facility**
Check this box only if the property owner is qualified under the regional convention facility authority act pursuant to the Michigan Sales and Use Tax Acts MCL 205.54d(m) and MCL 205.94 (z), respectively. This exemption is limited to tangible personal property acquired before January 1, 2014.

☐ **Church Sanctuary**
Check this box only if the property owner is a religious organization qualified under section 501(c)(3) of the Internal Revenue Code and the material will be affixed to the designated exempt portion of the building defined by law as a sanctuary that is or will upon completion be used predominantly and regularly for religious worship. (Attach verification of 501(c)(3) status from the Internal Revenue Service).

Optional: For a church sanctuary, a percentage can be used to determine the exempt portion of a piece of equipment or an order of materials to be used in taxable and nontaxable areas. The percentage is a fraction, the numerator of which is the square footage of the sanctuary and the denominator is the square footage of the entire building.

Square footage of sanctuary	Square footage of entire building
Percentage of the building that constitutes a sanctuary (rounded to the nearest one-hundredth)	

The undersigned property owner states that the attached documentation (if applicable) and the representations on this form are true and acknowledges that the contractor, the seller, and the State of Michigan may rely upon this form to determine qualifications for tax exemption.

Property Owner Name	Telephone Number
Herkimer Apartments LDHALP	(616) 454-0928
Property Street Address: 323 Division Avenue South	
City, State, ZIP Code: Grand Rapids, MI 49503	
Signature: Dennis Sturtevant, President of Herkimer Apartments NPHC, General Partner	Date Signed

CERTIFICATE OF APPROVAL OF
ARTICLES OF INCORPORATION OR AMENDMENTS
TO ARTICLES OF INCORPORATION

MICHIGAN STATE HOUSING DEVELOPMENT AUTHORITY
735 East Michigan Avenue, Lansing, Michigan 48912

In accordance with the provisions of Section 61, *et seq* of Act 346 of P.A. 1966, as amended, the Michigan State Housing Development Authority (the "Authority") consents to and approves the attached Articles of Incorporation submitted in the name of Herkimer Apartments Nonprofit Housing Corporation of the City of Grand Rapids, Kent County, Michigan, dated October 20, 2011, and consents to the filing thereof with the Bureau of Commercial Services, Michigan Department of Licensing and Regulatory Affairs.

In certification of the above, the undersigned executes this Certificate on behalf of the Authority.

MICHIGAN STATE HOUSING
DEVELOPMENT AUTHORITY

Dated: November 8, 2011

By: _____
Clarence L. Stone, Jr.
Its: Acting Director of Legal Affairs

Legal 009

11/08/2011 4:20PM (GMT 05:00)

Michigan Department of Treasury
Form 3372 (Rev. 11-09)

Michigan Sales and Use Tax Certificate of Exemption

DO NOT send to the Department of Treasury. Certificate must be retained in the Seller's Records. This certificate is invalid unless all four sections are completed by the purchaser.

SECTION 1: TYPE OF PURCHASE

☐ One-time purchase.
Order or Invoice Number: _____

☐ Blanket certificate.
Expiration Date (maximum of four years):_____

☐ Blanket Certificate. Recurring business relationship

The purchaser hereby claims exemption on the purchase of tangible personal property and selected services made from the vendor listed below. This certifies that this claim is based upon the purchaser's proposed use of the items or services, OR the status of the purchaser.

Vendor's Name and Address

SECTION 2: ITEMS COVERED BY THIS CERTIFICATE

Check one of the following:

1. ☐ All items purchased
2. ☐ Limited to the following items: _____

SECTION 3: BASIS FOR EXEMPTION CLAIM

Check one of the following:

1. ☐ For Resale at Retail. Enter Sales Tax License Number: _____
2. ☐ For Lease. Enter Use Tax Registration Number:_____

The following exemptions DO NOT require the purchaser to provide a number:

3. ☐ For Resale at wholesale
4. ☐ Agricultural Production. Enter percentage: _____%
5. ☐ Industrial Processing. Enter percentage: _____%
6. ☐ Church, Government Entity, Nonprofit School, or Nonprofit Hospital (Circle type of organization)
7. ☐ Nonprofit Internal Revenue Code Section 501(c)(3) or 501(c)(4) Exempt Organization (must provide IRS authorized letter with this form)
8. ☐ Nonprofit Organization with an authorized letter issued by the Michigan Department of Treasury prior to June 1994 (must provide copy of letter with this form)
9. ☐ Rolling Stock purchased by an Interstate Motor Carrier
10. ☒ Other (explain): Qualified Nonprofit Housing

SECTION 4: CERTIFICATION

I declare, under penalty of perjury, that the information on this certificate is true, that I have consulted the statutes, administrative rules and other sources of law applicable to my exemption, and that I have exercised reasonable care in assuring that my claim of exemption is valid under Michigan law. In the event this claim is disallowed, I accept full responsibility for the payment of tax, penalty and any accrued interest, including, if necessary, reimbursement to the vendor for tax and accrued interest.

Type of Business (see codes on page 2)	Business Name
Business Address	City, State, ZIP Code
Business Telephone Number (include area code)	Name (Print or Type)
Signature and Title	Date Signed

Michigan Department of Treasury
Form 3372 (Rev. 11-09)

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Type of Business (see codes on page 2)	Business Name
Business Address	City, State, ZIP Code
Business Telephone Number (include area code)	Name (Print or Type)
Signature and Title	Date Signed

END OF SECTION
MICHIGAN SALES and USE TAX EXEMPTION

SECTION 01 21 00

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cash allowances.
2. Contingency allowance.

B. Include in Contract Sum cash allowances contingency allowance specified in this Section.

1.02 CASH ALLOWANCES

A. General:

1. Purchase products under each allowance as directed by Architect.

2. Amount of allowance includes:

a. Net cost of product, less any applicable trade discounts.
b. Delivery to site.
c. Applicable taxes.
d. Labor required under allowance, only when labor is specified to be included in allowance.

3. In addition to amounts of allowances, include in Contract Sum costs for:

a. Handling at site, including unloading, uncrating, and storing.
b. Protection from elements and from damage.
c. Labor required for installation and finishing, except where labor is specified to be part of allowance.
d. Other expenses required to complete installation.
e. Overhead and profit.

B. Selection of Products:

1. Architect's Duties:

a. Consult with Construction Manager in consideration of products and suppliers.
b. Make selection; designate products to be used.
c. Prepare Change Orders.

2. Construction Manager's Duties:

a. Assist Architect in determining;
i. Supplier or installer, as applicable.
ii. Cost, delivered and unloaded at site.

b. Obtain proposals from suppliers when requested by Architect.
c. Notify Architect of any effect anticipated by selection of product or supplier under consideration on construction schedule or contract sum.
d. On notification of selection, enter into purchase agreement with designated supplier.

C. Delivery:

1. Construction Manager's Duties:

a. Arrange for delivery and unloading.
b. Promptly inspect products for damage or defects.
c. Submit any claims for transportation damage.

D. Installation: Comply with requirements of referenced specification section.

E. Adjustment of Costs:

1. Should actual purchase cost be more or less than specified amount of allowance, Contract Sum will be adjusted by Change Order equal to amount of difference.

2. Amount of Change Order will recognize any changes in handling costs at site, labor, installation costs, overhead, profit, and other expenses caused by selection under allowance.

3. For products specified under unit cost allowance, unit cost shall apply to quantity listed in Schedule of Values.

4. Submit invoices or other data to substantiate quantity actually used.

5. Submit as claims for additional costs at site or other expenses caused by selection under allowances, prior to execution of work. Failure to do so will constitute waiver of claims for additional costs.

1.03 CONTINGENCY ALLOWANCE

A. Construction Manager's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

B. Funds will be drawn from Contingency Allowance only by Change Order.

C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 ALLOWANCE SCHEDULE

A. Section 04 01 22 – Masonry Restoration Sand/Lime Masonry Units

1. Include a cash allowance of $650.00 per 1000 sand/lime for purchase of masonry units.

2. Installation is not included in amount of allowance and is to be included in Contract Sum.

B. Carpentry – Section 06 10 00

1. Carry cash allowance of $250,000 for unforeseen conditions discovered during Selective Demolition operation.

END OF SECTION 01 21 00
ALLOWANCES

SECTION 02 41 13

SITE DEMOLITION

PART 1 GENERAL

1.01 DESCRIPTION

A. Demolition, removal of existing equipment, and related work necessary to complete the project as shown or specified is a part of the Contract unless otherwise noted.

B. Deliver salvaged equipment to the OWNER except that designated as scrap or for reuse on site.

C. Plug abandoned utilities with concrete or grout.

1.02 PERMITS

A. Permit for transport and disposal of debris, by CONTRACTOR.

B. Submit demolition procedures and operational sequence for review and approval by ENGINEER.

1.03 PROTECTION

A. Do not interfere with site operation.

B. Provide and place bracing or shoring as required for safety and/or support of structures.

C. Protect and maintain utility services.

PART 2 PRODUCTS

2.01 MATERIALS

A. The CONTRACTOR maintains possession of all materials being demolished.

B. Carefully remove, store and protect for reinstallation all equipment so designated.

C. Carefully remove, clean and deliver salvaged materials to the OWNER'S storage area.

PART 3 EXECUTION

3.01 DEMOLITION

A. Completely demolish above grade structures and appurtenances to extent indicated on drawings and in specifications. Remove all scrap materials from site. Demolish in an orderly and careful manner. Install plugs or blind flanges on pipes as indicated or implied.

B. Remove existing below grade walls, columns, slabs, foundations, and piers which are in the same location as proposed structures to a depth of at least two (2) feet below the bottom of the new structures. Remove other walls, columns, slabs, foundations, and piers in their entirety.

C. Properly disconnect, seal and plug all utility services, such as gas, electric, water and sewer, to buildings and structures to be demolished. Restrain joints of existing utilities to remain in service per technical specifications for new construction.

D. Do not remove underground piping which is to be abandoned, except where it interferes with new construction or is specifically noted for removal. Plug cut ends of abandoned underground piping with non-shrink grout.

E. The structures to be demolished include: (See Removal Plan)

1. Retaining Walls
2. Wood Fencing
3. Underground utilities in alley and on site
4. Above-ground utilities in alley and on site
5. Sidewalks and curbing
6. Additional Items per plans
7. Decorative Metal Fence at Division Avenue sidewalk with gate
8. Wood stair and earth berm at Division Avenue sidewalk
9. HVAC condensing units serving Division Avenue commercial spaces in Herkimer
10. Stair and CMU stairway at Herkimer

F. Structures to be relocated include:

1. God's Kitchen dumpster and dumpster pad
2. God's Kitchen HVAC condensing units
3. Trash chute

3.02 REPAIR

A. Repair damage to adjacent structures, piping, and conduits.

3.03 Storm Sewer in Goodrich – provide temporary pump and maintain operation of this sewer during foundation construction along Goodrich Street between alley and Commerce Avenue.

END OF SECTION 02 41 13
SITE DEMOLITION

SECTION 03 10 00

CONCRETE FORMWORK

PART 1 – GENERAL

1.1 Related Documents

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. The Work under this Section includes all design, material, labor, equipment and supervision to install shoring and formwork for cast-in-place concrete and accessories as shown on the Drawings.

B. Install into formwork items furnished by others, including, but not limited to the following:

1. Anchor bolts
2. Setting plates
3. Bearing plates
4. Anchorages
5. Sleeves
6. Inserts
7. Frames
8. Nosings
9. Other miscellaneous items required to be embedded in the concrete, but not including reinforcing steel.

1.3 Related Work

A. The following work is related to this Section:

1.	Section 03 20 00	Concrete Reinforcement
2.	Section 03 10 05	Concrete Accessories
3.	Section 03 30 00	Cast-in-Place Concrete
4.	Section 03 45 00	Architectural Precast Concrete

1.4 Reference Standards

A. Work shall conform to the latest edition of the following:

1. ACI 301, "Specifications for Structural Concrete for Buildings".

2. ACI 347, "Recommended Practice for Concrete Formwork".

3. Structural properties of steel formwork: American Iron and Steel Institute (AISI) "Specification for the Design of Light Gauge Cold-formed Steel Structural Members".

4. Welding shall conform to American Welding Society (AWS) "Structural Welding Code - Steel D1.1".

1.5 Design

A. The design, construction, erection, maintenance and removal of forms shall be the responsibility of the Contractor.

1. Design all formwork in accordance with ACI 347 and ACI 301.

2. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces, the structure, or adjacent materials.

3. Carry vertical and lateral loads to the ground by the formwork system and by the cast-in-place construction that has attained adequate strength for that purpose.

4. Formwork shall be braced to prevent displacement under vibration or sagging between supports.

1.6 Quality Assurance

A. Materials and installed work may be reviewed by the Engineer at any time during the progress of the Work. Allow free access to facilities for this purpose. Provide 48 hours notice to Engineer to inspect completed forms prior to placement of concrete.

1.7 Delivery, Storage and Handling

A. Store all formwork and formwork materials clear of ground, protected, so as to preclude damage.

PART 2 – PRODUCTS

2.1 Form Materials

A. Forms for exposed finish concrete:

1. Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

B. Forms for unexposed finish concrete:

1. Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal and other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 Form Coatings

A. Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces to be cured with water or curing compound.

2.3 Form Ties and Spreaders

A. Commercially fabricated, adjustable-length, stainless steel, AISI 302/304, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

B. Ties used in sections which will not have either side exposed to view need not have "break-back" feature.

C. All other ties shall have cones and be designed to break back to allow a minimum 1-1/2 inch cover over ends or portions of ties remaining in this section. Ties shall not leave a hole larger than one inch diameter in concrete surface.

PART 3 – EXECUTION

3.1 Inspection

A. Inspect area to receive the work and report immediately in writing to the Engineer, as required in the General Conditions, any unacceptable conditions.

3.2 General

A. Construct forms to the precise sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in the finished structures.

B. Provide for openings, offsets, keyways, reglets, blocking, screeds, bulkheads, anchorages and inserts, and other features required on the work.

C. Kerf wood inserts for forming keyways, reglets, recesses and the like, to prevent swelling and assure ease of removal.

D. Provide all openings in forms to accommodate other work, including mechanical and electrical work. Place and anchor all items required to be built into the forms.

E. Chamfer all exposed corners, using wood, metal, PVC or rubber chamfer strips fabricated to produce smooth form lines and tight edge joints.

3.3 Falsework

A. Erect falsework, support, brace and maintain to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by the in-place concrete structure.

B. Construct falsework so that adjustment can be made for take-up and settlement.

3.4 Cleaning and Tightening

A. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed. Re-tighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.5 Installation of Embedded Items

A. Set and build into Work anchorage devices and other embedded items required for other Work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto. All embedded items used for attachment of formwork to concrete and other miscellaneous items shall be epoxy coated.

B. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.6 Preparation of Form Surfaces

A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

B. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do no allow excess form-coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

C. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

D. Form joints in all exposed concrete surfaces shall be securely taped or sealed by other approved means to prevent leakage and loss of paste during placement of concrete.

E. Remove form coating and residue from reinforcement or surfaces not required form coating.

3.7 Shores and Supports

A. Comply with ACI 347 for stripping, shoring, reshoring and removal of reshores.

B. Extend shoring at least 3 floors under floor or roof being placed. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores. Space shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.

C. All wood forms for columns shall be securely tied together with adjustable steel clamps, spaced so as to insure an absolute rigid form in conformance with the printed tables of the clamp manufacturer.

D. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support Work without excessive stress or deflection.

E. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.8 Removal of Forms

A. Concrete formwork shall not be disturbed until the concrete has hardened to be able to support its own weight plus a minimum of 20 psf construction load. Form removal requires simultaneous reshoring. Reshoring must remain in place until concrete has attained design strength, but in no case sooner than the limits set forth as follows:

1. Forms for continuous and spread footings: 24 hours after concrete has been placed.

2. Forms for supported slabs and beams: After full post-tensioning has been applied.

B. Field cured cylinders may be used for this determination by the Contractor.

C. Support for forms shall consist of wood or steel posts of a size and spacing as required to support the weight of the forms, concrete and construction live load. Each post shall be secured against horizontal movement by bracing in both longitudinal and transverse directions. Posts shall be braced at intermediate levels when more than twelve (12) feet high.

D. The Contractor shall be responsible for the adequacy of the number and location of reshores but the minimum amount of reshoring provided shall consist of shores placed under one floor immediately below the one being poured. These shores shall be located under the centers of beams and slab bands and under slabs along a line midway between supports.

E. The attention of the Contractor is called to the statement that the above requirements are minimum requirements and that the shores and/or reshores shall be kept in place for a sufficient length of time to assure the safety of the structure.

3.9 Re-Use of Forms

A. Clean and repair surfaces of forms to be re-used in Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets.

C. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

3.10 Tolerances

A. Construct formwork to provide completed concrete surfaces complying with the tolerances specified in ACI 347.

B. Check the lines and levels of the completed formwork for all exposed columns, spandrels, etc. before concrete is placed. Make whatever corrections or adjustments to the formwork that may be required to correct any deviation which exceed specified tolerances.

C. Check formwork during concrete placement to ensure that forms, shores, falsework, ties and other features have not been disturbed by concrete placement methods or equipment.

D. Comply with ACI 301, Chapter 4.

END OF SECTION 03 10 00
CONCRETE FORMWORK

SECTION 03 10 05

CONCRETE ACCESSORIES

PART 1 - GENERAL

1.1 Related Documents

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. The work includes all materials, equipment, labor and supervision to furnish and install all concrete accessories as herein defined and as shown on the Drawings, including all anchor bolts, inserts, plates, angles, sleeves, nailing blocks or other embedded items furnished as specified under this Division. The Work also includes installing concrete accessories shown on the Drawings and furnished by other trades or by the Owner.

1.3 Related Work

A. The following work is related to this Section:

1.	Section 03 10 00	Concrete Formwork
2.	Section 03 20 00	Concrete Reinforcement
3.	Section 03 30 00	Cast-in-Place Concrete

B. Coordinate and control the proper placing of all embedded pipe, conduit, and other fixtures. ACI 318, Article 6.3, applies to all cases of embedded fixtures.

1.4 Reference Standards

A. "Specifications for Structural Concrete for Buildings" (ACI 301), by the American Concrete Institute, herein referred to as ACI 301, is included in total as specification for this structure except as otherwise specified herein.

B. Comply with the provisions of the following codes, specifications and standards (latest edition) except where more stringent requirements are shown on the Drawings or specified herein.

1. "Building Code Requirements for Reinforced Concrete" (ACI 318), American Concrete Institute.

2. "Recommended Practice for Concrete Formwork" (ACI 347), American Concrete Institute.

3. "Manual of Standard Practice for Detailing Reinforced Concrete Structures (ACI 315)", American Concrete Institute.

4. "Manual of Standard Practice", MSP-2-77, Concrete Reinforcing Steel Institute.

5. "Structural Welding Code - Reinforcing Steel" AWS D1.4, American Welding Society.

6. "Structural Welding Code - Steel", AWS D1.1, American Welding Society.

7. "Standards of the American Society for Testing and Materials (ASTM)," as cited.

8. AASHTO "Standard Specifications for Highway Bridges."

9. "Specifications for Structural Concrete for Buildings" (ACI 301), American Concrete Institute.

10. "PCI Design Handbook", by the Prestressed Concrete Institute.

11. "PCI Architectural Precast Concrete" by the Prestressed Concrete Institute.

12. "PCI Manual for Structural Design of Architectural Precast Concrete" (Publication No. MNL-121-77) by Prestressed Concrete Institute.

13. "Manual for Quality Control for Plants & Production of Precast Prestressed Concrete Products" (Publication No. MNL-117-77) by the Prestressed Concrete Institute.

14. "Manual for Quality Control for Plants & Production of Architectural Precast Concrete Products" (Publication No. MNL-117-77) by the Prestressed Concrete Institute.

1.5 Delivery, Storage and Handling

A. Deliver concrete accessories to the Project site bundled or packaged, tagged and marked indicating the product, size, manufacturer and other identifying information.

B. Store materials at the site in such a way to maintain them dry, undamaged and clean.

1.6 Submittals

A. Submit samples of each type of concrete accessory to the Engineer for approval.

PART 2 - MATERIALS

2.1 Chemical Bond Anchor Bolt

A. Provide sizes and types of bolts as indicated on the Drawings.

B. Provide one of the following embedded anchor systems:

1. "HILTI HY-150 Fastening System" by Hilti, Inc. Fastening Systems

2. "HILTI HY-20 Fastening System" by Hilti, Inc. Fastening Systems

3. "HILTI HVA Adhesive Anchors" By Hilti, Inc. Fastening Systems

4. "Molly Parabond Capsule Anchors" By Molly Fastener Group

5. or Approved Equivalent.

C. All threaded rods, nuts, and bolts to be (hot dipped galvanized, zinc plated, stainless steel).

2.2 Anchor Bolts

A. Provide sizes as shown on Drawings.

B. ASTM A36.

2.3 Expansion Bolts

A. Provide sizes as shown on Drawings.

B. All anchors and associated hardware to be (stainless steel, zinc plated, hot dipped galvanized).

C. Approved expansion anchor systems:

1. "Kwik Bolt II", by Hilti.

2. Approved Equivalent.

2.4 Reinforcing Steel Chemical Anchorage Systems

A. "HILTI HY-150 Fastening System" by Hilti, Inc. Fastening Systems.

B. "HILTI HVA Adhesive Anchors" by Hilti, Inc. Fastening Systems.

C. "HILTI HY-20 Fastening System" by Hilti, Inc. Fastening Systems.

D. "Molly Parabond Capsule Anchors" by Molly Fastener Group.

E. Engineer Approved Equivalent.

2.5 Inserts and Coil Rods

A. All coil rods and inserts shall be galvanized, ASTM A164, Type G5, unless other noted otherwise on Drawings.

B. Yield strength 65,000 psi.

C. Inserts and coil rods shall be of the size called for on the Drawings. Approved manufacturers are:

1. Acrow-Richmond Limited

2. Dayton-Superior Concrete Accessories, Inc.

2.6 Permanent Compressible Joint Filler

A. Joint filler in slabs and curbs - as indicated on the Drawings. Acceptable products are:

1. "Expansion-Joint Filler" by Sonneborn Building Products, Minneapolis, MN

2. "Ceramar Flexible Foam Expansion-Joint" by W. R. Meadows, Elgin, IL

3. or Approved Equivalent.

B. Joint filler used vertically to isolate walls from columns or other walls - white molded polystyrene beadboard type, as indicated on the Drawings.

2.7 Temporary Compressible Joint Filler

A. Joint filler in slabs, curbs, and walls which must be removed prior to joint sealant installation, as indicated on the Drawings. Acceptable products are:

1. White molded polystyrene beadboard

2. or Approved Equivalent.

2.8 Noncompressible Joint Filler

A. Acceptable noncompressible joint filler products are:

1. "Styrofoam SM" furnished in 2" or 1" thick sheets as manufactured by the Dow Chemical Co.

2. or Approved Equivalent.

B. Filler Adhesive:

1. "General Purpose Mastic No. 11" by Dow Chemical Co.

2. or Approved Equivalent.

2.9 Miscellaneous Joint Filler

A. Joint filler in slab on grade adjacent to foundation walls and for sidewalk joints.

1. "Sealtight Asphalt Expansion Joint Filler" by W.R. Meadows, Inc.

2. or Approved Equivalent.

2.10 Earth Dams

A. "Sealtight" Premolded Membrane - #740 by W.R. Meadows, Inc.

2.11 Slide Bearing Systems

A. Provide slide bearing systems as shown and detailed on the Drawings.

B. Reinforced teflon consisting of 100 percent virgin tetrafluoroethylene polymer and ground glass fiber reinforcing aggregate, prebonded to backing materials. Acceptable slide bearing systems are: "Fluorogold" by Fluorocarbon, Pine Brook, NJ, and "Balco" by Balco, Inc., Wichita, KS.

Backing material for reinforced teflon slide bearing systems shall be:

1. Galvanized steel

2. Stainless steel

3. Reinforced elastomer, having a durometer hardness of 90, plus or minus 5, and meeting the requirements of Article 2.10.3(L) of the AASHTO Standard Specifications for Highway Bridges (1977).

C. Ultrahigh molecular weight, high-density polyethylene resin. Acceptable material is:

1. "Korolath PE" by Koro Corporation, Hudson, MA

2. or Approved Equivalent.

2.12 Stair Tread Nosings

A. Extruded aluminum, two component with embedded sub-channel and replaceable vandal-proof abrasive tread plate. Use Balco DXH-330 or Approved Equivalent.

B. See Architectural

2.13 Joint Cover

A. Aluminum extruded joint cover for 1" joint capable of 1" movement, use Balco 6FT-1.

B. See Architectural

PART 3 - EXECUTION

3.1 Inspection

A. Inspect area to receive the work and report immediately in writing to the Engineer, as required in the General Conditions, any unacceptable conditions.

3.2 Installation

A. All anchor bolts, inserts, plates, angles, sleeves, nailing blocks or other embedded items, whether furnished as specified under this Division, or other Divisions, furnished by other trades or by the Owner, shall be installed by this Contractor. Anchor bolts, unless specifically furnished by others, shall be furnished by this Contractor.

B. The Contractor shall be responsible for controlling the proper placing of all embedded pipe, conduit, and other fixtures. ACI 318, Article 6.3, shall apply to all cases of embedded fixtures. Minimum cover requirements for reinforcing shall apply to all embedded items unless shown otherwise on the Drawings.

C. Use suitable templates to accurately set and support against displacement all bolts, inserts, sleeves or other embedded items.

D. Cast anchor bolts in the top of cast-in-place concrete columns for light standards. Templates and anchor bolts shall be supplied by the light standard manufacturer.

END OF SECTION 03 10 05
CONCRETE ACCESSORIES

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 Related Documents

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. This work includes the supply, fabrication and installation of reinforcing steel for cast-in-place concrete.

1.3 Related Work

A. The following work is related to this Section:

1. Section 03 30 00 Concrete Cast-In-Place Concrete

1.4 Reference Standards

A. Comply with the provisions of the latest edition of the following Codes, Specifications, and standards except where more stringent requirements are shown on the Drawings or specified herein.

1. ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures", as published by the American Concrete Institute.

2. ACI 318 "Building Code Requirements for Reinforced Concrete", as published by the American Concrete Institute.

3. AWS D1.4 "Structural Welding Code - Reinforcing Steel", as published by the American Welding Society.

4. Concrete Reinforcing Steel Institute, "Placing Reinforcing Bars".

5. ACI 301 "Specifications for Structural Concrete for Buildings".

6. CRSI "Guidelines for Inspection and Acceptance of Epoxy Coated Reinforcing Bars at the Jobsite".

7. Standards of the American Society for Testing and Materials (ASTM) as cited.

1.5 Certification

A. Materials certifications signed by the manufacturer and the Contractor are required certifying that components used in Concrete Reinforcement meet or exceed specified requirements. Provide the Engineer with written certification from the

coating manufacturer that the coating resin for steel reinforcement has been approved by the National Bureau of Standards.

1.6 Delivery, Storage and Handling

A. Deliver all reinforcement to the project site bundled, tagged and marked. Use metal tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams. Handle and store materials to prevent damage, rust, or contamination. Store reinforcing steel on supports above ground level. Protect from weather. Deliver and store welding electrodes in accordance with AWS D1.4.

1.7 Basis of Payment

A. New reinforcing steel shown in the details is to be provided as part of the cost of full depth and partial depth repairs.

B. State in the bid form the unit cost for each of the following including all labor, materials, equipment, supervision, overhead and profit.

PART 2 - PRODUCTS

2.1 Reinforcing Materials

A. Reinforcing Bars: All reinforcing steel to be epoxy coated as described below, unless otherwise noted on the Drawings, or within the Specifications.

1. ANSI/ASTM A615, grade 60, unless noted.

2.2 Supports for Reinforcement

A. Provide stainless steel or plastic tipped supports for reinforcement in contact with formwork, including bolsters, chairs, spacers and other devices for spacing, supporting, and fastening reinforcing bars in place. Use wire bar type supports complying with CRSI recommendations.

B. Supports, including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place shall be manufactured from a dielectric material; or wire bar supports shall be coated with dielectric material, such as epoxy or vinyl; compatible with concrete.

C. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

D. Supports for bars shall be placed at 4'-0" maximum spacing each way. Supports shall be placed a maximum of 6 inches from ends of the reinforcement.

2.3 Tie Wire

A. Tie wire shall be plastic or vinyl coated for all epoxy coated reinforcement.

2.4 Reinforcing Steel Chemical Anchorages

A. Provide sizes and types of anchorages as indicated on the Drawings.

B. Provide one of the following embedded anchor systems:

1. "HILTI HIT HY 150 or HSE 2421 Epoxy Adhesive Anchors" by HILTI, Inc. Fastening Systems.

2. "SET High Strength Epoxy" by Simpson Strong Tie Company, Pleasonton, CA.

3. "Epcon C6 Fast Curing Epoxy" by ITW Ramset, Wood Dale, IL

4. or Approved Equivalent.

2.5 Field Applied Cold Galvanizing

A. Use the following, where noted, after abrasive blasting steel to near white metal"

1. "Z.R.C. Cold Galvanizing Compound" by Z.R.C. Products Co., Quincy, MA.

2. or Approved Equivalent.

B. Cold galvanizing is not a substitute for epoxy coating. Use only as directed on Drawings and Specifications.

PART 3 - EXECUTION

3.1 Inspection

A. Inspect area to receive the work and report immediately in writing to the Engineer, as required in the General Conditions, any unacceptable conditions.

3.2 Placing Reinforcement

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement of loose rust and mill scale, oil, earth, ice, and other materials which reduce bond with concrete.

C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.3 Splices

A. Provide standard reinforcement splices as shown on the Drawings by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.

END OF SECTION 03 20 00
CONCRETE REINFORCEMENT

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 Related Documents

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. Cast-in-place concrete as shown on Drawings.

1.3 Related Work

A. The following work is related to this Section:

1.	Section 01400	Quality Control
1a.	Section 01410	Testing Requirements
2.	Section 03100	Concrete Formwork
3.	Section 0320 00	Concrete Reinforcement
4.	Section 03 10 05	Concrete Accessories
5.	Section 03450	Architectural Precast Concrete

1.4 Reference Standards

A. Comply to the latest edition of the following Codes or Standards:

1. ACI-301 "Specification for Structural Concrete for Buildings," by the American Concrete Institute.

2. ACI-318 "Building Code Requirements for Reinforced Concrete," by the American Concrete Institute.

3. ACI-347 "Recommended Practice for Concrete Formwork," by the American Concrete Institute.

4. ACI-315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures," by the American Concrete Institute.

5. ACI 306.1 "Recommended Practice for Cold Weather Concreting," by the American Concrete Institute.

6. ACI 305 "Recommended Practice for Hot Weather Concreting," by the American Concrete Institute.

7. ACI 304R "Recommended Practice Guide for Measuring, Mixing, Transporting, and Placing Concrete," by the American Concrete Institute.

8. Standards of the American Society for Testing and Materials (ASTM), as cited.

9. AWS D1.1, "Structural Welding Code-Steel," by the American Welding Society.

10. AWS D1.4, "Structural Welding Code-Reinforcing Steel," by the American Welding Society.

11. FHWA-RD-77-85, "Sampling and Testing for Chloride Ion in Concrete," by the Federal Highway Administration.

12. AASHTO T 260-84, "Method of Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials," by AASHTO.

1.5 Environmental Requirements

A. Cold weather concreting: In accordance with ACI 306.1.

B. Hot weather concreting: In accordance with ACI 305.

C. Inclement Weather:

1. Unless adequate protection is provided, concrete shall not be placed during rain, sleet or snow.

2. Rain water shall not be allowed to increase mixing water nor to damage the surface finish.

1.6 Scheduling

A. Coordinate work with that of other trades to allow reasonable time to set sleeves, inserts and other accessories.

B. Notify the Engineer and the testing agency at least 24 hours prior to placing any concrete.

1.7 Submittals

A. Submit all materials and methods for concrete curing to the Engineer for approval prior to beginning concreting work.

B. For each strength and type of concrete, the Contractor shall be responsible for mix proportions and have a concrete design mix (proportions) prepared by the Redi-Mix supplier or an independent testing laboratory. Latex and microsilica modified concrete mix designs shall be reviewed and agreed to by the manufacturers. Proper Proportions for the design mixes shall be in accordance with "Standard Recommended Practice for Selecting Proportions for Normal, Heavy Weight, and Mass Concrete" ACI Standard 211 or according to ACI 318 and ACI 301, Sections 3.8 and 3.9.

C. Submit each concrete mix design to the Engineer a minimum of three weeks prior to placing concrete. Proportion mix designs as defined in ACI 301 Article 3.9. Include the following information for each concrete mix design:

1. Method used to determine the proposed mix design, (per ACI 301 Article 3.9).

2. Gradation and quantity of fine and coarse aggregates.

3. Proportions of all ingredients including all admixtures added either at the time of batching or at the job site.

4. Water-cement ratio or water-(cement + microsilica + fly ash) ratio.

5. Slump - ASTM C143 - latest edition.

6. Certification and test results of the total water soluble chloride ion content of the design mix - FHWA RD-77 Sampling and Testing for Chloride Ion Content. or AASHTO T 260-84.

7. Air content of freshly mixed concrete by the pressure method, ASTM C231 - latest edition, or the volumetric method, ASTM C173 - latest edition.

8. Unit weight of concrete - ASTM C138 - latest edition.

9. Strength at 7 and 28 days - ASTM C39 - latest edition, typ., also provide 3 day strength for post-tensioned concrete. Document strength based on basis of previous field experience or trial mixtures per ACI 301 Article 3.9. Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength.

10. Fly ash chemical analysis and certification of compliance with ASTM C618 Class C or F and specified carbon content.

D. The Contractor shall warrant by the submission of the design mix that such mix is totally representative of the concrete(s) that he intends to supply to meet the requirements of the Contract Documents. The Contractor shall submit new design mixes for review when any change in materials is required or needed.

E. Upon request from the Engineer, the Contractor shall submit certified cement mill test reports to the Engineer for each type and run of cement used in the work (ASTM C150).

F. Upon request from the Engineer, the Contractor shall submit certified laboratory chemical and other analyses for aggregates and admixtures as deemed necessary.

1.8 For Contractor testing responsibilities, see General Requirements, Section 01410.

PART 2 - PRODUCTS

2.1 Portland Cement

A. ASTM C-150, Type I or Type III, use only one brand of cement throughout the Project, unless otherwise approved.

2.2 Aggregates (ACI 301, Article 2.4)

A. Aggregates for all normal weight concrete (including footings) shall conform to ASTM C33 and shall have a total water soluble chloride ion content below 0.01 2 percent by weight of aggregate, unless a higher limit is approved by the Engineer and corrosion inhibitors added to the mixture to offset the additional chloride.

B. Coarse aggregate shall be crushed stone, gravel, or other approved inert materials of similar characteristics, unless noted otherwise below, and meet ASTM C33. Class Designation as follows:

1. Footings: Class 1S

2. Walls: Class 4S 5S. Crushed limestone only at elevator machine room walls above construction joint as elevation 662'- 0".

3. Columns, beams, slabs, precast panels and wall caps, and all other members: crushed limestone only, Class 5S.

C. Fine aggregate shall be natural sand, or sand prepared from stone or gravel. Grains shall be clean, hard, durable, uncoated and free from silt, loam and clay.

D. Maximum aggregate size and ASTM C-33 gradation requirements:

1. Footings and Piers: 1 inch, size 56.

2. All other members 3/4 inch, size 6.

2.3 Water

A. Potable

2.4 Curing Compounds

A. Acceptable for use on slabs-on-grade

B. Must pass ASTM C-309 at a maximum moisture loss of 0.030 g/cm2.

C. Must be compatible with other slab treatments and finishes, e.g. paint stripes, sealants, etc., or be removed by this Contractor.

D. Must be approved by Engineer. Sodium silicates not allowed.

E. ASTM C-309, Type I, of proper composition to prevent altering the surface color of the concrete and allow bonding of other materials to concrete.

F. Curing compounds is to be applied at a rate equal to or exceeding the rate necessary to pass ASTM C309.

2.5 Admixtures (ACI 301, Article 2.2)

A. Admixtures may be used by the Contractor at no additional expense to the Owner in order to provide workability at low water-cement ratios, increased compressive strength, retarding or acceleration of the concrete if approved in writing by the Engineer; however, the cement factor shall not be reduced, and changes shall be made in the other mix proportions to insure the minimum strength and durability requirements.

B. Use approved admixtures in strict accordance with manufacturer's recommendations.

C. Calcium chloride or admixtures containing more chloride ions than are contained in municipal drinking water are prohibited. The total chloride ion level of the admixtures must be below 1.0% by weight.

D. Air entraining admixture - ASTM C260

E. Water reducing admixtures:

1. ASTM C494, Type A

2. Acceptable materials are:

a. "Plastocrete 161" by Sika Chemical

b. "Eucon WR-75" by Euclid Chemical Company

c. "WRDA with Hycol" by W.R. Grace

d. "Polyheed 997" by Master Builders

F. High range water reducing admixture (superplasticizer):

1. ASTM C494, Type A or F

2. Acceptable materials are:

a. "Melment L10" by American Admixtures Corp.

b. "DARACEM 19" by W.R. Grace

c. "Rheobuild 1000" by Master Builders

3. Use shall not change the requirement of:

a. Water-cementitious materials cement ratios

b. Concrete strength

c. Air content

d. Minimum cement content

e. Specification for placing, finishing, and curing

G. Non-chloride accelerator

1. ASTM C494, Type C or E

2. Acceptable manufacturers are:

a. "Accelguard 80" by Euclid Chemical Co.

b. "Type C Set Accelerator" by W.R. Grace

c. "Pozzutec 20" by Master Builders

H. Fly ash

1. Fly ash, if used, shall not exceed more than 15 percent by weight of the cement in the mix design. Fly ash shall conform to ASTM C618, Class F, testing per ASTM C311. Carbon content not to exceed 4 percent.

2. Use of fly ash shall not alter specified levels of air entrainment nor reduce the strength requirements within the specified time period for post-tensioned beams and slabs in Section 03210. 03365.

I. Corrosion Inhibitors

1. Calcium nitrate based, meeting ASTM C494, Type C.

2. Acceptable manufacturers:

a. "DCI Corrosion Inhibitor" by W.R. Grace

b. or Approved Equivalent.

2.6 Grout

A. For surfaces "exposed to public view" and where indicated on the Drawings, use non-shrink, non-stain grout in strict accordance with manufacturer's recommendations.

1. 28-day strength: 6000 psi per ASTM C109.

2. Conform to "Corps of Engineers Specification for Non-Shrink Grout" CRD-C621-80.

3. The color of cured grout used on cast-in-place and precast concrete shall match the color of surrounding concrete. Note microsilica concrete surfaces will be darker than conventional concrete.

B. Acceptable materials are:

1. "Euco NS" by Euclid Chemical Company

2. "Five Star Grout" by U.S. Grout Corporation

3. "Masterflow 713" by Master Builders

2.7 Concrete Mix Design and Test Report Information

A. Refer to Section 01410 01400 and 03300.1.8.

B. Strength of concrete - (ACI 301 Article 3.2) determined in accordance with ASTM C39.

Item	f`c, psi 28 days	w/c max.	total air content
Footings/Grade Beams	4000	0.45	no test
Basement Walls, Ret. Walls	4000	0.45	6-1/2% ± 1-1/2%
Sidewalks, Drives, Misc.	4000	0.42	6-1/2% ± 1-1/2%
Columns, Beams, Slabs, Precast	6000	0.40	6-1/2% ± 1-1/2%

C. Concrete shown but not indicated or scheduled for strength - 4000 psi, water-cement ratio 0.42 max., air-entrained, 6-1/2 percent plus or minus 1-1/2 percent.

D. Slump - ASTM C143 as determined by mix design. See 2.7. - Latest Edition - shown on Drawings.

E. Air content of freshly mixed concrete by the pressure method, ASTM C231 - Latest Edition or the volumetric method, ASTM C173 -Latest Edition - shown on Drawings.

F. Air content of hardened concrete by microscopical determination -ASTM C457 - Latest Edition (Linear Traverse Method).

G. Concrete temperature (at placement time)

H. Air temperature (at placement time)

I. Cement factors: Concrete exposed to cyclic freezing and thawing in the completed project -six sacks of cement (564 lbs) minimum per cubic yard of concrete. All foundation walls, sidewalks and slabs on grade, and superstructure concrete is considered exposed to freezing and thawing.

J. Total water soluble chloride ion content by weight of cement and of concrete design mix, FHWA RD-77, or AASHTO T260-84.

K. See General Requirements for additional information required on the test report.

2.8 Air Entrainment

A. Hardened air entrained concrete shall have an air void spacing factor of 0.008 in. maximum; with a specific surface of 600 square inches per cubic inch of air void volume, minimum.

2.9 **Slump** (ACI 301, Article 3.5)

A. Contractor will provide slump guidelines adhering to strength and water/cement ratio requirements. Mix design shall provide slump for concrete prior to and after addition of superplasticizers.

2.10 Water-Cementitious Materials Cement Ratio

A. The water-cementitious materials cement ratio shall not exceed scheduled value including any water added to meet specified slump in accordance with the requirements of ASTM C94. Weight of fly ash or microsilica additives shall not be included within the weight of cement used to determine the water-cementitious materials cement ratio.

2.11 Chloride Ion Content

A. The total water soluble chloride ion content of the mix including all constituents shall not exceed 0.01 0.15 percent by weight of cement. the design mix in accordance with FHWA RD-77.

2.12 Evaluation and Acceptance of Concrete

A. In accordance with ACI 301, except where otherwise specified. See General Requirements for testing requirement of Contractor.

B. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements, the Contractor shall have his laboratory modify the design, subject to approval, until the specified concrete is obtained.

2.13 Moisture-Retaining Cover

A. Moisture retaining cover shall be one of the following, complying with ANSI/ASTM C171:

1. Waterproof paper over burlap

2. White polyethylene film over burlap

3. White polyethylene-coated burlap

2.14 Evaporation Retarder Moisture Barrier

A. "Confilm" by Master Builders

B. "Eucobar" by Euclid Chemical Company

PART 3 - EXECUTION

3.1 Inspection

A. Inspect area to receive the work and report immediately in writing to the Engineer, as required in the General Conditions, any unacceptable conditions.

3.2 Mixing

A. All concrete shall be ready-mixed conforming to ASTM C94 except as follows:

1. Provide concrete materials, proportions and properties as herein specified in lieu of C94 Section 4.

2. Water, beyond that required by the design mix, shall not be added at the site.

3. Furnish delivery ticket with each load of concrete delivered to the site to the Contractor. In addition to the requirements of ASTM C94 Section 16, provide the following information on the delivery tickets:

a. Type and brand of cement
b. Cement content per cubic yard of concrete
c. Type and maximum size aggregate
d. Total water content
e. Air Entrainment
f. Slump
g. Water-cementitious materials cement ratio
h. Fly ash content per cubic yard of concrete

B. High range water reducing agents (superplasticizer), if added at the batch plant, shall not again be added at the job site. If superplasticizers are added at the batch plant, the concrete delivery time, placement, and finishing procedures shall account for the limited time of the affect of the superplasticizer. If added at the site, test for air after proper mixing.

3.3 Placing

A. Before placing concrete, formwork shall have been completed, foreign material shall have been removed, reinforcement shall have been secured in place and the entire preparation shall have been reviewed by the Engineer prior to placing concrete. Engineer shall be notified at least 48 hours prior to desired time of review.

B. Immediately prior to the placing of concrete, the Contractor shall thoroughly clean all forms of foreign matter and remove all wood spreaders. Convey concrete from mixer to designation as rapidly as practicable and by methods which will prevent segregation or loss of ingredients. Concrete shall be poured in one operation up to temporary bulkheads.

C. All concrete shall be placed with the aid of mechanical vibrators of approved type. Enough vibration shall be used to cause all concrete to flow or settle readily into place. Vibrators must not be allowed to touch reinforcement embedded in partially set concrete nor used to transport concrete in forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

D. During the periods of setting, no materials shall be placed and no loads imposed in any manner of the slabs. Plank runways for the accommodation of workmen or for other traffic shall be supported by blocking.

E. Place concrete only when temperature is at least 40 degrees F and rising, or when air temperatures are not expected to exceed 80 degrees F during placing and finishing operations. If these conditions are not met, Refer to ACI 305 "Hot Weather Concreting" (3.7.D) and ACI 306.1 "Cold Weather Concreting" (3.7.D) for hot and cold weather placement requirements.

3.4 Finishing

A. Formed Surfaces: ACI 301, Article 10.2 and 10.4.

1. For all concrete surfaces "exposed to public view," use smooth form finish.
2. For all other concrete, standard form finish.

B. Flat work in parking and drive areas floated finish per ACI 301, 11.7.4.

1. Begin floating immediately after screeding of concrete.

2. Finishing tolerance - Class B, true planes within 1/4 inch in 10 feet as determined by a 10-foot straight edge placed anywhere on the slab in any direction ($F_f = 25$, $F_l = 25$).

3. Give the slab surfaces not to receive a deck coating a medium broom finish. Ridges shall not exceed 3/16 inch in height. The Engineer shall be notified to observe and approve the finish texture. Area to receive a deck coating shall have a finish approved by the coating manufacturers and by the Engineer (typically a smooth floated finish).

4. No refloating is required.

5. Finish all concrete slabs to proper elevations to insure that all surface moisture will drain freely to floor drains, that no puddle areas exist, and clearances are provided. Positive drainage and maintaining headroom clearance of 7'-0" minimum are the responsibility of this Contractor. Notify the Engineer of grades shown on the Drawings which do not allow for this so adjustments can be made. This Contractor shall bear the cost of any corrections to provide for positive drainage. The Contractor shall arrange for and flood all areas of the parking facility slabs with water for the purpose of detecting any defects in the concrete which would result in leaks and/or inadequate drainage. No finished spaces shall be insulated or ceilings installed until the flooding has been completed on the slab above and reviewed by the Engineer for acceptance.

B. Flat work in stair towers troweled finish per ACI 301, 11.7.3.

1. Give the slab a smooth, troweled finish

2. Finishing tolerance - Class B A, true planes within 1/4 1/8 inch in 10 feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction. ($F_f = 25$, $F_l = 25$).

3. Apply non-staining abrasive aggregate to stair landings and treads per manufacturer's specifications.

4. No spraying of water directly on flat work is allowed.

C. Microsilica - Additional Finishing Requirements

1. Finish concrete according to requirements of the microsilica manufacturer.

2. Note the use of microsilica and low water/cement ratio concrete will essentially eliminate bleed water. Contractor to finish concrete using procedures to preclude plastic and drying shrinkage cracking.

3. No spraying of water directly on flat work will be allowed. Fog misting the air above microsilica flat work is recommended. Free standing water is not allowed.

4. Fog misting is not to be used to apply water to the surface of the concrete to facilitate lubrication for finishing purposes.

5. Fog misting is required when conditions of hot weather concrete exist per item 03300 3.6.D. Fogging shall continue after the finishing operation until wet burlap or cotton mats are placed over the concrete.

D. Light sandblasted finish

1. Exposed vertical surfaces of cast-in-place and precast elements facing the exterior of the structure are to receive a light abrasive blast finish. Abrasive blasting shall remove all surface laitance and paste to expose fine aggregate. Protect adjacent surfaces from etching due to abrasive blasting. Protect adjoining properties, public thoroughfares, vehicles and pedestrians from damage or injury. Take necessary precautions to keep dust confined in the work area and to prevent unauthorized personnel form entering the work area.

3.5 Joints in concrete (ACI 301, Chapter 6)

A. Construction, control and isolation joints are located and detailed on the Drawings.

B. Tool slab joints at the time of finishing.

C. Isolation joints - interrupt structural continuity resulting from bond, reinforcement or keyway.

D. Construction and control joints in walls - space joints at maximum 10 feet on center unless a smaller spacing is shown on the Drawings.

E. Construction of control joints in floor slabs on grade - maximum slab area controlled by jointing 500 600 square feet. Space joints at 22 24 feet on center maximum unless a smaller spacing is shown on the Drawings.

F. Coordinate configuration of tooled joints with control joint sealants (Division 07).

G. No Soff-cut sawn control joints or equivalent with proper joint profile for sealant may be used.

3.6 Repair of Surface Defects (ACI 301, Chapter 9)

A. Match the color and texture of the concrete to be repaired.

B. Submit proprietary compound used for adhesion or patching ingredients to the Engineer for his review before patching concrete.

C. Receive the written approval of the Architect Engineer of method and materials prior to making structural repairs to concrete.

D. Contractor shall be responsible for routing and sealing all cracks in supported concrete floor slabs and curbs.

E. Formed Surfaces: Fill all air pockets and holes over 1/2 inch in diameter with a sand-cement paste. Grind smooth all form offsets or fins over 1/8 inch. Remove stains from rust, grease and oils, form release agents, dirt, etc.

3.7 Curing and Protection

A. Normal conditions

1. Protect concrete from premature drying, excessive hot or cold temperature, and mechanical injury. Concrete and concrete patching materials shall be cured according to the manufacturer's recommendations and according to the requirements of this specification.

2. Begin curing as soon as possible after concrete has been placed and finishing has been completed.

3. Cure all slabs on grade, concrete toppings, concrete pour strips and supported slabs not subject to conditions of hot or cold weather concreting using the method outlined in ACI 301, Article 12.2, 1.2. Unless otherwise noted, maintain concrete in a continuously moist condition for at least 7 days after placement.

B. Cold Weather Concreting ("Cold Weather Concreting", ACI 306.1 Report 306R-78)

1. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40 degrees F for more than three successive day), take additional precautions as specified herein and in "Cold Weather Concreting" by the American Concrete Institute (ACI Report 306R-78) when placing, curing, monitoring and protecting the fresh concrete.

2. Warm the mix water, sand and aggregate so that no frozen lumps of ice. snow or aggregate will survive mixing but do not overheat the ingredient to cause the flash setting of the concrete or loss of entrained air.

3. Place and maintain the internal concrete temperature as near to the minimums given in the following table:

Least Dimension of the Member	Minimum internal concrete temperature as placed and maintained
less that 12 in.	53 degrees F. (13 degrees C.)
12 to 36 in.	50 degrees F. (10 degrees C.)
36 to 72 in.	45 degrees F. (7 degrees C.)
greater than 72 in.	40 degrees F. (5 degrees C.)

Temperature of freshly placed concrete shall not exceed the given minimum placement temperature by more than 10 degrees F.

4. Begin protection and curing of the concrete immediately after placement to maintain internal temperature of the concrete at 50 degrees F or above (but not to exceed 70 degrees) throughout the curing process operation.

   a. Cure slabs on grade, foundations and substructures other than grade beams not subject to early loading at the placement temperature for two (2) days minimum.

   b. Temporary heaters used to maintain the temperature of the air surrounding exposed, uncured concrete during curing operations shall be the vented type, vented to outside of the protection envelope.

   c. Cure and protect concrete for supported slabs, beams, columns, and bumper walls at the temperature specified above until it attains 85 percent of the design strength.

   d. Determine the strength of the curing concrete by either of the following methods:

   e. Calculate the maturity factor based upon the curing time and the measured internal concrete temperature as described in Chapter 7 of ACI Report 306R-78.

   f. Cast and field-cure at least six test specimens from the last 50 cubic yards of concrete but not fewer than three specimens for each two hours of entire placing time or for each 50 cubic yards, whichever yields the greatest number of specimens. Make specimens in accordance with ASTM C31. Cover specimens properly immediately after finishing. Protect the outside surfaces of cardboard molds, if used, from contact with sources of water for the first 24 hours after molding. Field cure test specimens on the structure as near to the point of sampling as possible and protect them from the elements in the same manner as that given to the

portion of the structure as the specimen represents. Test cylinders in accordance with ASTM C31 and C39.

5. Cast expendable thermistors or thermo-couplers in the concrete at the rate of at least one per 100 cubic yards of concrete placed for supported structure. Monitor the internal temperature of the concrete at twelve hour maximum intervals throughout the curing process. Submit monitored results to the Engineer for review.

6. During the curing operation, maintain the temperature of the placed concrete as constant as possible, and protect from rapid atmospheric temperature changes.

7. Maintain the concrete in a continually moist condition during the curing process by leaving the forms in place as long as possible and by use of steam and/or moisture retaining covers on unformed surfaces.

8. Following the curing operation, avoid rapid changes in concrete temperature. Do not allow the internal temperature of the concrete to change at a rate which exceeds 50 degrees F in any 24 hour period or 5 degrees F in any one hour.

D. Hot Weather Concreting ("Hot Weather Concreting" ACI 305 by the American Concrete Institute Committee 305)

1. When concrete is placed under conditions of hot weather concreting, this Contractor shall provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations. Hot weather is defined as air temperature which exceed 80 degrees F or any combination of high temperature, low humidity and/or high wind velocity which caused a rate of evaporation in excess of 0.2 pounds per square feet per hour as determined by Figure 2.1.5 of ACI Report 305. Hot weather curing is required if these conditions occur within a 24 hour period after completion of concrete placement.

2. Forms, reinforcing and the air shall be cooled by water fog spraying immediately before placing concrete. The placement temperature of the concrete shall be 75 degrees to 80 degrees F.

3. Protect concrete during finishing operations by one of the following:

   a. Continuous fog spray over slab between finishing operations.

   b. Immediately following screeding, apply an evaporator retarding agent in accordance with the recommendations of the manufacturer.

4. Cover concrete with wet burlap or cotton mats as soon as the concrete will support it without deformation. Keep mats constantly wet for 7 days minimum. Leave mats in place for 3 additional days after discontinuing wetting process.

END OF SECTION 03 30 00
CAST-IN-PLACE CONCRETE

SECTION 03 30 30

UNDER-SLAB VAPOR BARRIER

PART 1 GENERAL

1.01 SUMMARY

A. Products supplied under this section:

1. Vapor barrier, seam tape, and mastic for installation under concrete slabs.

B. Related Sections:

1. Section 03 30 00 – Cast-in-Place Concrete.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM E 1745-09 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

2. ASTM E 154-99 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

3. ASTM E 96-05 Standard Test Methods for Water Vapor Transmission of Materials.

4. ASTM F 1249-06 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

5. ASMT E 1643-09 Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

B. American Concrete Institute (ACI):

1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.03 SUBMITTALS

A. Quality control/assurance:

1. Summary of test results as per paragraph 8.3 of ASTM E 1745.
2. Manufacturer’s samples, literature.
3. Manufacturer’s installation instructions for placement, seaming and penetration repair instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Vapor barrier must have all of the following qualities:

1. Permeance of less than 0.01 Perms [grains/(ft^2 · hr · inHg)]as tested in accordance with ASTM E 1745 Section 7.

2. Other performance criteria:
   a. Strength: ASTM E 1745 Class A.
   b. Thickness: 15 mils minimum.

B. Vapor barrier products:

1. Basis of Design: Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC.

2. Other acceptable products:
   a. Or equal products that meet all of the specified performance criteria in paragraph A.

2.02 ACCESSORIES

A. Seam Tape:

1. By vapor barrier manufacturer.

B. Vapor-proofing mastic:

1. By vapor barrier manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure that base material is approved by Architect or Geotechnical Engineer.

1. Level and compact base material.

3.02 INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E 1643.

1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement.
2. Lap vapor barrier over footings and/or seal to foundation walls.
3. Overlap joints six (6") inches and seal with manufacturer's tape.
4. Seal all penetrations (including pipes) per manufacturer's instructions.
5. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
6. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area six (6") inches and taping all sides with tape.

END OF SECTION 03 30 30
UNDER-SLAB VAPOR BARRIER

SECTION 03 34 00

PRE-CAST CONCRETE

PART 1 - GENERAL

1.1 Related Documents

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. The work of this Section shall include fabrication, delivery, and erection of precast concrete elements as shown and noted on Drawings and as specified herein. Some elements are to be designed by the precast concrete contractor.

1.3 Related Work

A. Related work specified elsewhere:

1.	Section 03 20 00	Concrete Reinforcing
2.	Section 03 30 00	Cast-in-Place Concrete
3.	Section 05120	Structural Steel

1.4 Summary

A. The intent of the drawings and specifications are to delineate the design and construction requirements for a structure which will be durable and require minimal long term maintenance in a geographic region with large seasonal temperature changes and high use of de-icing salts in the winter. This contractor is expected to be knowledgeable of these requirements and produce, erect, and assemble components in such a manner as to meet this intent. This contractor shall provide a stable structural frame in place ready to receive the structural topping and materials and installations by other contractors.

1.5 Design

A. The Drawings establish design intent for appearance, profiles and unit sizes:

1. The Drawings show structural reinforcing for column and shear wall elements designed to resist all final service loading conditions, and specific reinforcing and connections required of various members to resist the final service condition lateral loads imposed on the elements. Connections for all members for final service load conditions are shown on the Drawings.

2. Design of structural reinforcing required by precast concrete contractor:

a. All tees, beams, spandrels, and masonry backup elements.

1) Elements shall be designed to resist gravity loads as indicated on Drawings.

2) See General Notes on Drawings for material properties and imposed loadings.

3) Component design will be according to codes and standards referenced in Section 1.6.

4) Use a minimum concrete transfer compressive strength of 3500 psi, unless greater is required.

5) Allowable tensile stress in precast structural elements, except double tees, will be limited to 6 √f'c at typical floors, 7.5 √f'c at top levels.

6) See Drawings for additional information.

7) Allowable tensile stress on precast double tee units will be limited to 7.5 √f'c under 100 psf live load and 24.5 psf snow, 12 √f'c under full design loading. A soil load of 57 psf was used for 12" of lightweight soil.

b. All elements to resist handling, erection, and shipping load conditions.

3. Precast contractor will design all temporary connections required for erection.

4. Precast elements shall be designed to stand unshored (not necessarily unbraced) during cast-in-place concrete topping placement. Topping by General Contractor.

5. Modifications to the basic building structure to accommodate precast design will not be considered.

6. Friction through bearing pads for final connection calculations is not allowed.

7. Double tee bearing pads shall be designed for a minimum dead load bearing stress of 600 psi.

1.6 Reference Standards

A. Comply with the latest edition of the following, except as modified herein.

1. American Concrete Institute

a. ACI 318, Building Code Requirements for Reinforced Concrete

b. ACI 533, Precast Concrete Wall Panels

c. ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures

d. ACI 301, Specifications for Structural concrete for Buildings

2. American Welding Society

   a. AWS D1.1 Code for Welding in Building Construction

   b. AWS D1.4 Recommended Practices for Welding Steel, Metal Inserts and Connections in Reinforced Construction

3. Prestressed Concrete Institute

   a. "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products", PCI-MNL-116

   b. "PCI Design Hand Book", Third Edition

1.7 Quality Control

A. Quality Control and Plant Records

1. The precast manufacturer's plant shall be certified by the Prestressed Concrete Institute plant certification program prior to letting of this Contract. If requested, submit verification of this certification to the Architect for review.

2. Keep plant records of production and quality control in accordance with PCI MNL 116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products. Provide copies of reports to the Architect on a bi-weekly basis during production.

3. Maintain a record of all units that are damaged in plant operations or are rejected. These records shall show what remedial action was taken to obtain approval. Record finishing and patching procedures as well as patch mix designs. All plant patching to be accepted by Architect prior to shipping to job site.

B. Testing Procedures for Materials: See Section 01 40 05.

C. Provide reasonable access to all relevant plant operations for the Architect for the purpose of verifying the quality of the work. Supply materials required for independent testing.

D. Concrete Testing Requirements

1. The precaster shall perform and/or pay for compression tests for all precast concrete work. Testing is subject to observation by the Owners Testing Agency. Use certified test equipment. Unless otherwise specified, conform with:

   a. "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products," PCI MNL 116-85.

2. Sample, test, and report concrete in accordance with "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products," PCI MNL 116-85, with the following exceptions:

a. A pour is defined as 50 cubic yards (or fraction thereof) placed for each day of production.

b. Make six cylinders per pour: three at the beginning (labeled "A") and three at the end of the pour (labeled "B").

c. Only one "A" and one "B" cylinder made for each pour need be cured per MNL 116. Test these cylinders to verify concrete compressive strength at transfer of prestress.

d. Other cylinders may be moist cured and tested at 28 days to verify the design compressive strength of the concrete.

e. Discard remaining cylinders after 56 days upon approval of the Architect.

f. Conduct one air content test per ASTM C231 or ASTM C173 for every two double tee units and two per daily pour of each of the other member classes.

g. At ten random locations as selected by the Architect, core and test hardened concrete for air content per ASTM C457. The precast concrete contractor is responsible for patching these cores.

E. Fabrication Tolerances

1. Warpage

a. Bowing-concave or convex of any part of a flat surface shall not exceed length of bow/360 with a maximum of 3/4 inch, as measured by PCI standards.

b. Maximum warpage of one corner out of the plane of the other three shall be 1/16 inch per foot distance from the nearest adjacent corner as measured by PCI standards.

2. Dimensional tolerances of finished units: Overall height, length, and width measured at the face adjacent to the mold at time of casting:

a. Hollow Core

1) Length $\pm$ 3/4"

2) Width $\pm$ 1/4"Q

3) Depth $\pm$ 1/4"

4) Flange Thickness + 1/4" - 1/8"

5) Web Thickness $\pm$ 1/8"

6) Position of Tendons $\pm$ 1/4"

7) Camber differential 1/4" per 10', 3/4" max

8) Camber variation from design ± 1/4" per 10', ± 3/4" max

b. Openings within one unit: ± 1/4 inch

c. Out of square: 1/8 inch per 6 feet, or 1/4 inch total, whichever is greater.

d. Thickness: Total thickness shall be within 1/8 inch + 1/4 inch.

e. Tolerances on all other dimensions not specified above: The numerically greater of ± 1/16 inch per 10 feet or ± 1/8 inch.

3. Position Tolerances

a. Anchors and Inserts: Within 3/8 inch of centerline shown on Shop Drawings.

b. Blockouts and Reinforcement: Within 1/4 inch of position shown on Shop Drawings, where such positions have structural implication or affect concrete cover, otherwise within 1/2 inch.

c. Flashing Reglets: ± 1/4 inch, except ± 1/8 inch where flashing reglets are located at edge of panels.

4. Erection tolerances for location of precast units

a. Hollow Core

1) Plan location ± 1"

2) Top elevation from nominal top elevation at ends ± 1/2"

3) Alignment at matching edges ± 1/2"

4) Joint width ± 1/4"

F. This Contractor shall bear the expense of hiring an independent testing agency to inspect and verify quality of all shop welds. See Section 01 40 05.

G. For reinforcing and cast-in-hardware fabrication, all welding will be performed by welders with current AWS certifications for the required welding work.

1.8 Submittals

A. Submit detailed checked shop drawings prepared under the supervision of a registered professional engineer in the state of this project. Shop Drawings shall include, but not be limited to, the following:

1. Unit locations on erection plan

2. Reinforcement for each type of unit

3. Prestressing strand pattern

4. Profiles, joint and fabrication details

5. Unit identification marks

6. Connection details to adjacent units or other work

7. Details of typical and special anchors, inserts and lifting devices

8. Anchorage locations including column anchor bolts

9. Dimensions and relationship of adjacent material

B. All recommendations or requests by the manufacturer to change or supplement the anchoring, or the reinforcing steel shall be accompanied by complete engineering data to support the requested changes.

C. Concrete Mix Design

1. Submit each concrete mix design to the Architect a minimum of three weeks prior to placing concrete.

D. Submit test reports of concrete used in precast units biweekly during production of precast concrete elements.

E. Submit written certification that any form release agent or curing compound to be used has been tested with the types of concrete finish, topping and joint sealant specified, and that they are not harmful to the sealant or composite topping bonding properties.

F. Submit calculations performed and sealed by a structural engineer registered in the State of the project with five (5) years minimum experience in this kind of work for all precast element design.

G. Mill certificates: Submit two copies of manufacturer's certificates of mill tests of all prestressing steel and anchorage devices, and typical stress-strain curves for prestressing steel.

1.9 Samples

A. Submit samples of each type of concrete accessory to architect upon request.

B. Submit 12 x 12 x 1 panel samples of exterior finish mix designs and finish to Architect upon request.

1.10 Handling

A. Blocking material used shall be clean and non-staining and shall not prevent uniform curing of exposed surfaces. Lateral support shall be sufficient to prevent unacceptable bowing and warping.

B. Edges of units shall be adequately protected by padding or other means to prevent staining, chipping and spalling.

C. Mark all units with identification marks as to their location in the structure and date of production.

D. Incidental cracking of the flanges due to bending or warping during fabrication, handling, shipping, or erection of maximum width 10 mils is acceptable. All other types of cracks or damage will be evaluated by the Architect on an individual basis.

1.11 Transportation

A. Protect units transported to the site to prevent road grime or truck exhaust fumes from staining faces.

B. Supporting frames and tie-down equipment shall not damage or stain the exposed surfaces.

C. All precast units shall be delivered to the site completely finished.

PART 2 - PRODUCTS

2.1 Formwork

A. Provide forms and, where required, form facing materials of metal, plastic, wood, or other acceptable material that is non-reactive with concrete and will produce required finish surfaces.

B. Accurately construct forms, mortar-tight, and of sufficient strength to withstand pressures due to concrete placing pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines and dimensions indicated, within specified fabrication tolerances.

C. Unless forms for plant-manufactured prestressed concrete units are stripped prior to detensioning, design forms so that stresses are not induced in precast units due to deformation of concrete under prestress or to movement during detensioning.

D. Provide commercial formulated form coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments or concrete surfaces.

2.2 Concrete

A. See Section 03 30 00 for concrete requirements.

B. Grout

1. For surfaces "exposed to public view" and where indicated on the Drawings, use non-shrink, non-stain grout in strict accordance with manufacturer's recommendations.

a. 28-day strength: 6000 psi per ASTM C109

b. Conform to "Corps of Engineers Specification for Non-Shrink Grout" CRD-C621-80

c. The color of cured grout used on precast concrete "exposed to public view" shall match the color of surrounding concrete

2. Acceptable materials are:

a. "Euco NS" by Euclid Chemical Company

b. "Five Star Grout" by U.S. Grout Corporation

c. "Masterflow 713" by Master Builders

2.3 Mild Reinforcement

A. See Section 03 20 00 for mild reinforcing.

2.4 Prestressing Tendons

A. ASTM A416, uncoated seven wire low relaxation strand with 270,000 psi minimum ult. tensile strength, stress relieved strand may be used at contractors option.

2.5 Hardware

A. Miscellaneous plates and structural shapes, ASTM A36.

B. Hot dip galvanize all connection hardware per ASTM A153 and following:

1. Precautions recommended by the American Hot Dip Galvanizers Association.

2. ASTM recommended practice A143, "Safe Guarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement".

3. CSA specifications G164, "Galvanizing of irregularly shaped articles.

2.6 Concrete Accessories

A. See Section 03 10 05 for concrete accessories.

2.7 Design Mixes

A. See structural drawing for required compressive strength, air content and slump.

B. The concrete mix design shall be established by tests or trial batches to achieve the required specified strength. Tests will be necessary on all mixes proposed for use by the precast manufacturer (face, back-up or standard). Water content shall remain constant during manufacture.

C. See Section 03 30 00 for design mix requirements.

2.8 Bearing pads

A. See Drawings for type, size, thickness, and locations.

B. Hollow Core Tee bearings

1. Koro Lath plate.

2. Random fiber reinforced pads per Section 2.8.D.3.

C. Vertical joints between precast members

1. Pads will be structural grade neoprene or random oriented fiber reinforced elastomer pads as designated on drawings.

2. See Section 03 34 00, 2.8.b for neoprene pad requirements.

3. Random oriented fiber reinforced pads will meet the following criteria:

a. Durometer hardness 80 $\pm$ 5

b. 10,000 psi compressive load without cracking, splitting, or delaminating.

c. Acceptable products:

1) "Fibrelast" by Voss Engineering Co., Chicago, IL

2) "Masticord" by JVI Inc., Skokie, IL

E. Alternative bearing pad products may be used with submittal of criteria qualifications information, reviewed and approved by Architect.

F. Bearing Pad Shim stock "Korolath" by Koro Co., Cambridge, MA

2.9 Fabrication

A. Concrete Mixing, Placement and Consolidation

1. Batch concrete and mix in such manner and sequence that the mass in uniformly mixed and without harmful chemical reaction between admixtures or segregation of materials.

2. Inspect mixers and concrete transporting equipment and thoroughly clean prior to batching and periodically clean during casting operations.

3. Inspect aggregate storage areas, hopper gates and concrete handling equipment to ensure that all types of contaminating materials, rust particles, or old/hardened concrete cannot be introduced into the freshly batched concrete.

4. Deposit and vibrate concrete to ensure complete and uniform consolidation. The rate of placement or the alternating operations of mix placement and reinforcement shall be such that "lift lines" or "cold joints" do not occur and entrapped air is removed from the faces of the casting.

5. Apply form release agents according to the manufacturer's recommendations.

B. Reinforcement and Hardware

1. All reinforcing steel shall have a minimum cover of 1-1/4 inch, unless noted on drawings.

2 All anchor bolts, inserts, plates, angles, sleeves, nailing blocks or other embedded items, whether furnished as specified under this Division, or other Divisions, furnished by other trades or by the Owner, shall be installed by the precast concrete Contractor. Anchor bolts, unless specifically furnished by others, shall be furnished by this Contractor.

3. Embedded anchors, inserts, plates, angles and other cast-in items shall be galvanized or epoxy coated as indicated on Drawings and have sufficient anchorage and embeddment for the design requirements and stresses of form stripping, transportation and erection.

4. Use suitable templates to accurately set and support against displacement all bolts, inserts, sleeves or other embedded items.

5. Cast anchor bolts in the top of cast-in-place concrete columns for light standards. Templates and anchor bolts shall be supplied by the light standard manufacturer.

6. All welding shall be made in accordance with the applicable provisions of the American Welding Society.

C. Finishes

1. Structural precast concrete provide finishes per MNL-116 and as follows:

a. Formed Surfaces: Fill all air pockets and holes over 1/4 inch in diameter with a sand-cement paste. Grind smooth all form offsets or fins over 1/8 inch.

b. Columns
1) Unformed surface: face toward the inside of the parking structure.

2) Steel trowel the unformed side to a smooth, dense, hard finish as required for formed surfaces.

c. Beams and spandrel panels
1) Interior face: light broom finish in the horizontal direction. Standard finish on inverted tee beams.

2) Ends, bottom and top: smooth dense surface standard finish. Transverse rake top surface of inverted tee beams to 1/4 inch depth minimum to ensure bond of concrete topping.

3) Exterior face and exposed ends: formed surfaces.

d. Double tees

1) Top surface: transverse rough broomed to 3/16 inch depth minimum to ensure bond of the composite concrete topping.

2.10 Epoxy Coating for Field Weld Conditions and Strand Ends

A. Sikagard 62, gray in color, by Sika Corp., Lyndhurst, NJ

B. Or Architect Approved Equivalent.

PART 3 - EXECUTION

3.1 General

A. The precast concrete contractor is solely responsible for all guying, bracing, shoring, and erection connections required to maintain structural stability and safety for the structure subject to all construction loading conditions, from commencement of erection work to completion of all trades work.

B. Coordinate delivery and erection of precast concrete with other job-site operations.

C. Coordinate the arrival of precast units and provide for storage and erection in a safe manner within the agreed schedule, and in due consideration of other trades.

D. Precast concrete contractor will supply column anchor bolts and setting templates to General Contractor in ample time for General Contractor to build into foundations and not delay project. Precast contractor will inspect bolt placement and verify locations prior to commencing erection.

3.2 Installation

A. Do not install any unit until concrete has attained its design ultimate compressive strength and 28 days have passed since casting.

B. Erect all precast units level, plumb, square and true within allowable tolerances and according to the approved Shop Drawings. Position all units to eliminate cumulative dimensional errors.

C. Horizontal and vertical joints and edges shall be correctly aligned and maintain uniform joint width as erection progresses.

D. Secure each unit to the structure by welded or bolted connections as indicated on the structural Drawings.

E. Sequence of attachment shall be such that the supporting structural member is uniformly loaded.

F. Units may be rested on metal shims while being connected. Shims are the responsibility of the precast manufacturer. Metal shims are not allowed in permanent construction, this contractor will remove them prior to substantial completion of project.

G. At bolted connections, tack weld nuts, metal shims must be removed prior to placing topping.

H. Protect units and other portions of the Work from damage and staining by field welding or cutting operations.

I. All welds shall be coated with cold galvanizing immediately after welding and slagging in accordance with the manufacturer's recommendations. Epoxy coat assembly with Sikagard 62 epoxy coating in field where required on Drawings.

J. Powder-actuated fasteners shall not be used.

K. Adjustments or changes in connections, which could involve additional stresses in the units or connections, shall not be permitted without the approval of the Project Engineer.

L. After units are in place, grout any exposed lifting device hole with a non-stain, non-shrink grout to the finished surface.

M. After all precast concrete units have been set in place and before sealant work, glazing or other related work is begun, the work shall be inspected by the Project Engineer. Units found to be damaged and repaired will be evaluated at this time. Further remedial work may be authorized.

3.3 Damage and Repairs

A. Inspect and record any defects found on the individual units when they arrive at the site. Inform the Architect of damage that may cause rejection of the unit and obtain approval to use such a unit. plant damaged, and/or patched members must be reviewed and approved by the Architect prior to erection.

B. Damaged precast units shall be reviewed by the Architect for acceptance in the building. If the unit is in place, immediate remedial work shall be undertaken to effect an acceptable repair. If patches or remedial work is found not to be acceptable after sufficient time and attempts, the unit shall be removed and replaced.

C. Patch mix designs, use of bonding agents, patch application, curing and finishing procedures shall be approved by the Architect prior to commencing patching work.

3.4 Protection

A. Removal of staining of precast units due to rusting of temporary erection bracing and hardware is the responsibility of this contractor. After erection, protection of the precast units from water runoff, rust staining, painting and general clean-up operations will be the responsibility of the General Contractor.

B. Vehicles or machines that can damage edges or the surface of precast units shall be kept away.

3.5 Joint Sealants

A. The edges of the precast units and of adjacent materials shall be sound, smooth, clean and free of all contaminants prior to joint treatment.

3.6 Cleaning

A. Clean all exposed precast work as necessary to remove dirt and stains after erection and acceptance by the Engineer. The units shall be washed and rinsed in accordance with the precast manufacturer's recommendations.

B. Take precautions so that no part of the building or surrounding site work will be damaged or that the character of the architectural finishes shall not be changed by the cleaning materials or process.

END OF SECTION 03 34 00
PRE-CAST CONCRETE

SECTION 05 00 00

MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 Related Documents

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. Work includes providing all labor, materials, equipment, and supervision necessary to complete the installation of miscellaneous metals as shown on the Drawings and listed below:

1. Structural steel framing and supports
2. Miscellaneous metals as described herein

1.3 Related Work

A. The following work is related to this Section:

1.	Cast-in-Place Concrete	Section 03 30 00
2.	Structural Steel	Section 05120
3.	Steel Joists	Section 05210
4.	Metal Decking	Section 05300
5.	Handrails and Railings	Section 05520
6.	Painting	Section 09 90 00

1.4 Reference Standards

A. Comply with the provisions of the following codes and standards, latest editions:

1. Design, fabricate and erect miscellaneous metals in accordance with the American Institute of Steel Construction's (AISC) "Manual of Steel Construction," including "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", latest Edition.

2. AISI "Specifications for the Design of Cold-Formed Steel Structural Members".

3. AWS D-1.1 "Structural Welding Code - Steel".

4. ASTM A-6 "General Requirements for the Delivery of Rolled Steel Plates, Shapes Sheet Piling and Bars for Structural Use".

5. SSPC, Steel Structures Painting Council.

1.5 Submittals

A. Submit detailed checked shop drawings showing all information necessary for the fabrication and erection of all specially fabricated items. Include the following:

1. Location in building
2. Dimensions and weight of member(s)
3. Type and location of field and shop connections
4. Other pertinent erection details

B. Submit manufacturer's specifications, anchoring details, and installation instructions.

C. Submit one copy of each AWS welder certification prior to beginning work specified herein.

PART 2 - PRODUCTS

2.1 Structural Steel Plates, Shapes, Bars and Sheets

A. Structural - Sizes, Shapes & Plates: ASTM A 36, except for plates to be bent or cold-formed.

B. Plates to be bend or cold formed: ASTM A283, Grade C.

C. Bars & Bar-Size Shapes: ASTM A306, Grade 65, or ASTM A36.

D. Sheets: ASTM A446 with 1.25 oz. "Commercial" zinc coated in accordance with ASTM A525.

2.2 Steel Tubing

A. Cold Formed - ASTM A500, Grade B

B. Hot Formed - ASTM A501

2.3 Carbon Steel Pipe

A. ASTM A53; Type and grade as shown on the Drawings. (if acceptable) as selected by fabricator and as required for design.

2.4 Cold-Finished Steel Bars

A. ASTM A108, grade as selected by the fabricator.

2.5 Structural Steel Sheets and Strips

A. Hot Rolled: ASTM A570

B. Cold Rolled: ASTM A611, Class 1

C. Galvanized: ASTM A446 of a grade required for design loading

2.6 Aluminum Bars, Rods and Shapes

A. ASTM B221.

B. All aluminum surfaces shall be mill finished.

2.7 Anchors

A. Concrete Inserts

1. Threaded-Type: Galvanized ferrous castings, internally threaded to receive 3/4 inch diameter machine bolts. Use either malleable iron complying with ASTM A47 or cast steel complying with ASTM A26; hot-dip galvanized in accordance with ASTM A153.

a. Provide carbon steel bolts having special wedge-shaped heads, nuts, washers and shims; galvanized, ASTM A153.

b. Slotted Type: Galvanized 1/8 inch thick pressed steel plate ASTM A283; box type welded construction with slot designed to receive 3/4 inch diameter square head bolt and with knockout cover; hot dip galvanized, ASTM A386.

B. Toggle Bolts:

1. Tumble-wing type, FS FF-B-588, class and size as required.

2.8 Fasteners

Zinc-coated, galvanized for exterior use when used in exterior walls, in accordance with ASTM A153. Select fasteners for type grade and class required for installation of miscellaneous metal items.

1. Standard Bolts & Nuts: Regular hexagon head type, ASTM A307, Grade A.

2. Lag Bolts: Square head type, FS FF-B-561.

3. Machine Screws: Cadmium-plated steel, FS FF-S-92.

4. Wood Screws: Flat head carbon steel, FS FF-S-111.

5. Plain Washers: Round, general assemble grade carbon steel, FS FF-W-92.

6. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

2.9 Galvanizing

A. Provide a zinc coating for those items indicated or specified to be galvanized; unless otherwise specified, comply with the following:

1. Iron & Steel Hardware: ASTM A153.

2. Rolled, pressed and forged steel shapes, plates, bars and strip 1/8 inch thick and heavier: ASTM A123. (1.25 oz./sq. ft. min.)

3. Assembled Steel Products: ASTM A386. (1.25 oz./sq. ft. min.)

2.10 Shop Paint

See Section 09 90 00.

A. Ferrous Metal Primer: Fabricators standard rust-inhibitive primer.

B. Apply shop coat of paint on all steel surfaces except the following or as otherwise shown on the Drawings:

1. Members or portions of members to be embedded in concrete.

2. Galvanized items.

3. Surfaces of members to be field welded in immediate area of weld.

2.11 Grout

A. Non-Shrink Non-Metallic Grout:

1. Premixed, factory packaged, non-staining, non-corrosive, non-gaseous grout complying with CE CRD-C588. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this Section.

PART 3 - EXECUTION

3.1 Inspection

A. Inspect area to receive the work and report immediately in writing to the Architect, as required in the General Conditions, any unacceptable conditions. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner. Commencement of erection implies acceptance of related work.

3.2 Fabrication

A. General

1. Welding

a. Weld all shop connections and all field connections unless indicated or specified otherwise.

b. Weld corners and seams continuously and in accordance with requirements of the AWS Code.

c. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

d. Work performed only by welders qualified in accordance with requirements of the AWS Code.

2. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated or specified.

3. Cut, reinforce, drill and tap miscellaneous metal work as may be required to receive finish hardware and similar items of work.

4. Remove loose rust, mill scale, cutting and punching burrs.

B. Miscellaneous Framing and Supports

1. Fabricate miscellaneous units to sizes, shapes and profiles and of the necessary dimensions to receive adjacent grating, plates, doors or other work to be retained by the framing.

2. Fabricate from structural steel shapes and plates and steel bars of all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connections.

3. Space anchors 2 foot o.c., and provide minimum anchor units of 1-1/4 inch by 1/4 inch by 8 inch steel straps.

4. Galvanize exterior miscellaneous frames and supports.

C. Miscellaneous Steel Trim

1. Fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges.

2. Galvanize exterior miscellaneous steel trim.

3.3 Painting

A. Steel to receive sprayed on fire proofing shall not be painted.

B. Steel not receiving sprayed on fire proofing shall be painted or galvanized.

C. Interior Steel does not need to be painted.

D. Shop coat: Structural steel to be painted shall be given one shop coat of heavy-duty, rust-inhibiting, metal protecting prime paint. Minimum dry film thickness must be not less than two mils (0.002 inch). Approved primers included GUARDSMAN 11-750 Structural Steel Primer, DURAKO K-797 Alkaline Primer, RUST-OLEUM 1069 Heavy-Duty Rust inhibitive Red Primer, TNEMEC 99 Red Metal Primer or Sherwin Williams KROMIK Metal Primer #41N1. (Strikeout portion: moved to 2.4) Primer shall be applied in strict compliance with manufacturer's specifications and recommendations.

E. Field Painting: As soon as possible after being bolted up, all abrasions to shop coat and all bolts, washers, nuts, etc. shall be painted with same material as used for shop coat. No painting shall be done in freezing weather.

F. Final Paint Coat: See Division 9.

3.4 General Installation Requirements

A. Install manufactured items in strict accordance with manufacturer's current written instructions.

B. Set all work accurately to lines and levels, plumb and secure.

C. Install members, bolts, anchors, etc. to be covered, inserted or built-in as the Work progresses.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction.

E. All items of miscellaneous metal and related parts are not necessarily individually described. The most important and those requiring detailed description are usually mentioned.

F. Provide all other work as indicated on the Drawings or necessary to complete the miscellaneous metal work.

G. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

H. After erection and field welding, clean and paint all welds, bolt heads and nuts, and abraded and rusted areas using materials to match finish specified.

3.5 Cutting, Fitting and Placement

A. Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

3.6 Field Welding

A. Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

3.7 Setting Loose Plates

A. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

B. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout. Use metallic non-shrink grout in

concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed location, unless otherwise indicated.

C. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.8 Touch Up Galvanizing

A. Damaged galvanized surfaces shall be repaired by one of the following methods:

1. Sprayed zinc coating: Apply zinc coating by metalizing spray to clean and dry surfaces. See Section 5300, 2.1.D.

2. Zinc based solder and wire: Apply zinc alloy repair compound according to manufacturers instructions.

B. Dry film thickness of applied repair materials shall not be less than galvanizing coating thickness required by ASTM A123 or A153, as applicable.

3.9 Supply Only Items

A. Furnish anchor bolts, leveling plates, insert nuts and washers for installation as specified in Division 3. All such shall be supplied to Concrete Contractor in a timely fashion, and shall include instructions and templates.

3.10 Schedule Items

A. The schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.

1. Elevator Pit Ladder(s): Aluminum of 3/8" x 2-1/2" (9 x 62 mm) side rails spaced at 20" (500 mm) with radius top edge; rings of 1" (25 mm) diameter solid rod with non-slip surface spaced 12" (300 mm) on center to extend 48" (1.22m) above finish floor at lowest sill; space rings 7" (175mm) from wall surfaces with mounting brackets and attachments; mill finish.

2. Lintels: As detailed; galvanized finish.

3. Aluminum Grilles: As detailed, mill finish.

END OF SECTION 05 00 00
MISCELLANEOUS METALS

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

A. RELATED DOCUMENTS

a. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. SUMMARY

a. This Section includes following:

i. Steel framing and supports for mechanical and electrical equipment.

ii. Steel framing and supports for applications where framing and supports are not specified in other Sections, including truss bridging.

iii. Steel weld plates and angles for casting into concrete not specified in other Sections.

b. Products furnished, but not installed, under this Section include following:

i. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

c. Related Sections include following: 05 12 00 – Structural Steel

C. PERFORMANCE REQUIREMENTS

a. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

i. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. SUBMITTALS

a. Product Data: For following:

i. Nonslip aggregates and nonslip-aggregate surface finishes.
ii. Paint products.
iii. Grout.

b. Shop Drawings: Show fabrication and installation details for metal fabrications.

i. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

ii. Provide templates for anchors and bolts specified for installation under other Sections.

c. Welding certificates.

E. QUALITY ASSURANCE

a. Welding: Qualify procedures and personnel according to following:

i. AWS D1.1, "Structural Welding Code--Steel."

ii. AWS D1.3, "Structural Welding Code--Sheet Steel."

F. PROJECT CONDITIONS

a. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

i. Established Dimensions: Where field measurements cannot be made without delaying Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

ii. Provide allowance for trimming and fitting at site.

G. COORDINATION

a. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

b. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

A. MANUFACTURERS

a. In other Part 2 articles where titles below introduce lists, following requirements apply to product selection:

i. Products: Subject to compliance with requirements, provide one of products specified.

ii. Manufacturers: Subject to compliance with requirements, provide products by one of manufacturers specified.

B. METALS, GENERAL

a. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

C. FERROUS METALS

a. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

b. Steel Tubing: ASTM A 500, cold-formed steel tubing.

c. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

d. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-3.

i. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).

ii. Material: Galvanized steel complying with ASTM A 653/A 653M, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.

e. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

D. NONFERROUS METALS

a. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.

E. FASTENERS

a. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

b. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

c. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).

d. Anchor Bolts: ASTM F 1554, Grade 36.

i. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

e. Eyebolts: ASTM A 489.

f. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

g. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

h. Wood Screws: Flat head, ASME B18.6.1.

i. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

j. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

k. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, load equal to four times load imposed, as determined by testing according to ASTM E 488, conducted by qualified independent testing agency.

i. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

l. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, load equal to six times load imposed when installed in unit masonry and four times load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by qualified independent testing agency.

i. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

ii. Material for Anchors in Exterior Locations: Alloy Group 1 (A1) stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

F. MISCELLANEOUS MATERIALS

a. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

b. Shop Primers: Provide primers that comply with Division 9 painting Sections.

i. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

c. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

i. Use primer with VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

ii. Products:

1. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
2. Carboline Company; Carbozinc 621.
3. ICI Devoe Coatings; Catha-Coat 313.
4. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
5. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.

6. Tnemec Company, Inc.; Tneme-Zinc 90-97.

d. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

e. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

f. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

g. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

h. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

G. FABRICATION, GENERAL

a. Shop Assembly: Preassemble items in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

b. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

c. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

d. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

e. Weld corners and seams continuously to comply with following:

i. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

ii. Obtain fusion without undercut or overlap.

iii. Remove welding flux immediately.

iv. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

f. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

g. Fabricate seams and other connections that will be exposed to weather in manner to exclude water. Provide weep holes where water may accumulate.

h. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

i. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

i. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

H. MISCELLANEOUS FRAMING AND SUPPORTS

a. General: Provide steel framing and supports not specified in other Sections as needed to complete Work.

b. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

i. Fabricate units from slotted channel framing where indicated.

ii. Furnish inserts if units are installed after concrete is placed.

c. Galvanize miscellaneous framing and supports where indicated.

I. MISCELLANEOUS STEEL TRIM

a. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

b. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

i. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

c. Galvanize exterior miscellaneous steel trim.

J. ABRASIVE METAL NOSINGS

a. Cast-Metal Units: Cast aluminum, with an integral abrasive finish consisting of aluminum oxide, silicon carbide, or combination of both. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.

i. Manufacturers:

1. American Safety Tread Co., Inc.
2. Balco Inc.
3. Barry Pattern & Foundry Co., Inc.
4. Granite State Casting Co.
5. Safe-T-Metal Co.
6. Wooster Products Inc.

b. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or combination of both, in an epoxy-resin binder. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.

i. Manufacturers:

1. ACL Industries, Inc.
2. American Safety Tread Co., Inc.
3. Amstep Products.
4. Armstrong Products, Inc.
5. Balco Inc.
6. Granite State Casting Co.
7. Wooster Products Inc.

ii. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.

iii. Nosings: Square-back units, 3 inches (75 mm) wide, for casting into concrete steps.

c. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

d. Drill for mechanical anchors and countersink. Locate not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.

i. Provide 2 rows of holes for units more than 5 inches (125 mm) wide, with 2 holes aligned at ends and intermediate holes staggered.

e. Apply bituminous paint to concealed bottoms, sides, and edges of cast-metal units set into concrete.

f. Apply clear lacquer to concealed bottoms, sides, and edges of extruded units set into concrete.

K. FINISHES, GENERAL

a. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

b. Finish metal fabrications after assembly.

L. STEEL AND IRON FINISHES

a. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

i. ASTM A 123/A 123M, for galvanizing steel and iron products.

ii. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

b. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

i. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

ii. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

c. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

i. Stripe paint corners, crevices, bolts, welds, and sharp edges.

M. ALUMINUM FINISHES

a. Finish designations prefixed by AA comply with system established by Aluminum Association for designating aluminum finishes.

b. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

c. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAM611.

N. COPPER-ALLOY FINISHES

a. Finish designations for copper alloys comply with system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."

b. Extruded-Nickel Silver Finish: M11 (Mechanical Finish: specular, as fabricated).

PART 3 EXECUTION

A. INSTALLATION, GENERAL

a. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

b. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

c. Field Welding: Comply with following requirements:

i. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

ii. Obtain fusion without undercut or overlap.

iii. Remove welding flux immediately.

iv. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

d. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

e. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

B. INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

a. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

b. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. INSTALLING NOSINGS, TREADS, AND THRESHOLDS

a. Center nosings on tread widths.

b. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

D. ADJUSTING AND CLEANING

a. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

i. Apply by brush or spray to provide minimum 2.0-mil (0.05-mm) dry film thickness.

b. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00
METAL FABRICATIONS

SECTION 05 73 10

SRS STANDOFF GLASS RAILING SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Through Glass Point Supported Tempered Glass Guard Assemblies.

1.02 RELATED SECTIONS

A. Section 05 50 00 Metal Fabrications

B. Section 08 80 00 Glazing

1.03 REFERENCES

A. ASTM C 1048 – Standard Specification for Heat Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass.

B. NAAMM Metal Finishes Manual; National Association of Architectural Metal Manufacturers.

C. AAMA CW-12-84 Structural Properties of Glass.

D. ASTM E 2358-04 Standard specification for the Performance of Glass in Permanent Glass Railing Systems, Guards and Balustrades.

1.04 SYSTEM DESCRIPTION

A. Performance Requirements for Guard Assembly:

1. Support distributed loan of 50 pounds per linear foot (0.73kN/M), applied horizontally at right angles in any direction to the top/grab rail.

2. Support concentrated horizontal load of 200 pounds (0.89kN), applied in any direction at any point along top/grab rail.

3. 50 lbs. (0.22kN) on 1 sf (0.093m^2) perpendicular to guard at any location.

4. These loads need not be assumed to act concurrently.

5. Maximum deflection at top of glass is height/24.

1.05 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Submit Manufacturer's technical product data for railing components and accessories.

C. Shop Drawings: Dimensioned drawings of railing assemblies indicating the following:

1. Elevations; include joint locations, transitions, and terminations.

2. Glass light fabrication plans with dimensions, holes and finishes.

3. Point support layout, details and attachment to support structure.

4. Manufacturer's installation and maintenance instructions.

D. Engineering Design Report: Calculations showing point support reactions and glass stresses.

E. Samples of manufacturer's finishes (As selected by Architect).

1.06 QUALITY ASSURANCE

A. Components and installation are to be in accordance with state and local building codes.

B. All components and fittings are furnished by the same manufacturer.

C. All glass to be fabricated by an approved temperer to a tolerance of 1/32" for the light size and hole locations.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials properly protected against damage to finished surfaces during transit.

B. Inspect materials upon delivery for damage. Unless minor defects can be made to meet the Architect's specifications and satisfaction, damaged parts shall be removed and replaced.

C. Store materials at building site under cover in a dry location.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: C.R. Laurence Co., Inc. (CRL); Tel: (800) 421-6144; Fax: (800) 587-7501; Email: railings @crlaurence.com; www.crlaurence.com.

B. Manufacturer's of equivalent products will be considered for substitution in accordance with provisions of Division 01 – Production Substitution Procedures.

2.02 MATERIALS

A. Aluminum Components: Conforming to ASTM B 221/ASMT B221M, Alloy 6063-T52.

B. Stainless Steel Components: Conforming to ASTM A 666, Type 304.

C. Brass Components: Conforming to ASTM B 248, No. 260, Satin Chrome.

2.03 COMPONENTS

A. Glazing: Fully tempered ASTM C 1048 Kind FT, Quality q3. As specified in Section 08 80 00.

1. Thickness: 3/4 inch (19 mm).
2. Color: Clear low iron glass.
3. Polished edge on exposed glass edges:

B. Internal Handrail Cap Connection Sleeves: Metal tube, material compatible with handrail cap material.

C. CRL Standoff fittings

D. Cap Railing: Part # GR15, round 1-1/2 inches (38.1 mm) diameter.

E. Fasteners: Types and sizes indicated in shop drawings and engineering report.

2.04 FABRICATION

A. Fabricate handrail assembly components to lengths and configurations complying with shop drawings.

B. Machine joint edges smooth and plane to produce hairline seams when site assembled; supply concealed sleeve connectors for joints.

C. Isolate dissimilar metals to prevent electrolytic action by applying primer to concealed surfaces of metal components.

PART 3 INSTALLATION

3.01 GENERAL

A. Install handrails in accordance with manufacturer’s recommended installation instructions and approved shop drawings. Standoffs shall be located to a tolerance of 1/32”. All bushings, spaces, bearing pads and other components shown in the shop drawings must be properly installed.

3.02 CLEANING

A. Clean glazing surfaces after installation, complying with requirements contained in the manufacturer’s instructions. Remove excess glazing sealant compounds, dirt or other substances.

B. Remove protective films from metal surfaces.

C. Clean railing surfaces with clean water and mild detergent. Do not use abrasive chemicals, detergents, or other implements that may mar or gouge the material.

3.03 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that all the materials do not incur any damage or deterioration.

B. Repair components damaged by subsequent construction activities in accordance with manufacturer's recommendations; replace damaged components that cannot be repaired to Architect's acceptance.

END OF SECTION 05 73 10
SRS STANDOFF GLASS RAILING SYSTEM

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 Related Documents

The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. In accordance with Contract Documents, provide all labor, material, equipment, and services to furnish and install Rough Carpentry.

B. Definition: Rough carpentry includes carpentry Work not specified as part of other Sections and generally not exposed, except as otherwise shown. Types of Work in this Section include rough carpentry for:

1. Wood grounds, nailers and blocking.

2. Wood furring.

3. Miscellaneous wood framing.

4. Plywood backing panels for mounting electrical equipment.

C. Wood Nailer/Curbs and Cants are specified in this Division but furnished and installed by roofing contractor under Section 07510.

1.3 Related Work

A. Provide for coordination of Work under this Section with Work installed by others under other Sections.

1.4 Reference Standards

A. American Institute of Timber Construction

1. AITC "Timber Construction Manual"

2. AITC Standard 104 "Typical Construction Details"

B. American Plywood Association (APA):

1. APA, "Design/Construction Guide - Residential & Commercial".

2. APA, "Product Guide - Grades & Specifications".

C. American Wood Preservers Association (AWPA):

1. AWPA, "Book of Standards".

D. National Fire Protection Association (NFPA):

E. American & Paperl Forest Products Association (AF&PA):

1. AF&PA, "Manual for House Framing".

2. AF&PA, "National Design Specification for Wood Construction". (NDS)

F. Product Standard of National Bureau of Standards (NBS):

1. PS 1, "U.S. Product Standard for Construction and Industrial Plywood".

2. PS 20, "Softwood Lumber Standard".

G. Southern Pine Inspection Bureau (SPIB):

H. Western Wood Products Association (WWPA):

1. WWPA A-2, "Lumber Specification Information".

2. WWPA, "Western Woods Use Book".

1.5 Quality Assurance

A. Lumber Standards: Comply with NBS PS 20 and with applicable rules of respective grading and inspecting agencies for species and products indicated.

B. Plywood Product Standards: Comply with NBS PS 1 or, for products not manufactured under PS 1 provisions, with applicable APA Performance Standard for type of panel indicated.

C. Grade Mark: All lumber and plywood shall be identified by official grade mark. Grade stamp to contain symbol of grading agency certified by Board of Review, American Lumber Standards Committee, mill number or name, grade of lumber, species grouping or combination designation, rules under which graded where applicable, and condition of seasoning at time of manufacture.

1.6 Submittals

A. Shop Drawings

B. Materials Data

1. List type and grade of framing lumber, type and thickness of sheathing materials and types of fasteners to be used.

C. Exterior Wood Treatment Data: Submit treatment manufacturer's instructions for proper use of each type of treated material:

1. Pressure Treatment: For each type specified, include certification by treating plant stating chemicals and process used, net amount of preservative retained, and conformance with applicable standards.

2. Water-Borne Preservatives: Include statement that moisture content of treated materials was reduced to maximum of 15% before shipment to Project site.

1.7 Delivery, Storage, and Handling

A. Deliver rough carpentry materials to site ready for use, with each piece of lumber clearly marked as to grade and type.

B. Deliver rough hardware in sealed containers bearing labels as to type and kind.

C. Set lumber for rough usage, when delivered to site, in stacks to insure proper drainage and free circulation. Support stacks on skids and cover with tarpaulins or other watertight coverings to protect from elements.

D. Do not store seasoned lumber in wet or damp portions of building.

E. Remove delivered materials which do not conform to specified grading rules or are otherwise not suitable for installation from Project site and replace with acceptable materials.

PART 2 - PRODUCTS

2.1 General, Lumber

A. Sizes indicated on Drawings or specified are nominal sizes, except where finished dimensions are stated. Actual dimensions shall conform to PS 20 for moisture content specified for each use:

B. Provide dressed lumber, S4S, unless otherwise indicated.

C. Provide seasoned lumber with 15% maximum moisture content at time of dressing.

2.2 Framing Lumber

A. For structural framing (2" to 4" thick, 5" & wider), provide Southern Pine No. 1, 2 or better.

2.3 Boards (less than 2" thick)

A. Concealed Boards: Where boards will be concealed by other work, provide Southern Pine No. 2 or better.

2.4 Miscellaneous Lumber

Provide wood for support or attachment of other Work including cant strips, bucks, nailing, block, furring, grounds, stripping, and similar members. Provide lumber of sizes indicated, worked into shapes shown.

2.5 Plywood

A. Trademark: Identify each plywood panel with appropriate APA trademark.

B. Concealed Performance-Rated Plywood: Comply with requirements indicated for grade designation, span rating, exposure durability classification, edge detail, and required thickness:

1. Sheathing and Subflooring: For wall and roof sheathing and for subflooring, where shown on Drawing, provide APA CDX grade plywood panels with grade designation, APA C-D EXTERIOR GLUE, in thickness indicated or, if not otherwise indicated, not less than 3/4".

2.6 Wood Treatment

A. Preservative Treatment: Where lumber or plywood is indicated as "Trt-Wd" or "Treated", or is specified in this Section to be treated, comply with applicable requirements of AWPA Standards C2 (lumber), and C9 (plywood)

B. Treat indicated items and following:

1. Wood cants, nailers, curbs, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing members less than 18" above grade.

C. Complete fabrication of treated items before treatment where possible. If cut or drilled after treatment, treated lumber/ plywood shall be treated in accordance with AWPA Standard M4. Inspect each piece of lumber or plywood, after drying, and discard damaged or defective pieces.

2.7 Miscellaneous Materials

A. Fasteners and Anchorages: Provide size, type, material, and finish as shown and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers, and anchoring devices.

B. Provide metal hangers and framing anchors of size and type recommended by manufacturer for each use including recommended nails.

C. Fasteners used with treated lumber shall be hot-dipped zinc coated unless otherwise recommended by lumber treatment manufacturer.

PART 3 - EXECUTION

3.1 Inspection

A. Inspect area to receive the work and report immediately in writing to the Engineer, as required in the General Conditions, any unacceptable conditions. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner. Commencement of work implies acceptance of related work.

3.2 Preparation

A. Verify measurements taken at Project site affecting Work. Any field dimensions, which are at variance should be brought to attention of Engineer. Obtain decision regarding corrective measures from Engineer before start of fabrication of items affected.

B. Coordination: Fit carpentry Work to other Work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow proper attachment of other Work.

3.3 Installation

A. General:

1. Discard units of material with defects which might impair quality of Work, and units too small to use in fabricating Work with minimum joints or optimum joint arrangement.

2. Set carpentry Work accurately to required levels and lines, members plumb, true, and accurately cut and fitted.

3. Do no shimming without acceptance from Engineer, except where required to true up furring, blocking, and similar items. If shimming is required for installation of hardware, use metal or fiber shims. Cardboard shims are not permitted.

4. Except as indicated otherwise, all grounds or furring strips shall be 1-1/2" wide, of required thickness, and in no case less than 3/4" thick.

5. Grounds, blocking, furring, and all other rough carpentry items shall be furnished and installed with as few joints as possible to accommodate Work of other Sections as noted on Drawings or as required to suit conditions encountered in field.

B. Wood Grounds, Nailers, Blocking, and Sleepers:

1. Provide wherever shown and where required for screening or attachment of other Work. Form to shapes as shown and cut as required for true line and level of Work involved.

2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry Work. Where possible, anchor to formwork before concrete placement.

3. Provide permanent grounds of dressed, preservative-treated, key-beveled lumber not less than 1-1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

C. Wood Furring:

1. Install plumb and level with closure strips at edges and openings. Shim with galvanized metal or fiber shims as required for tolerance of finished Work. Cardboard shims are not permitted.

2. Firestop furred spaces on walls at each floor level, with wood blocking or incombustible materials, accurately fitted to close furred spaces.

D. Wood Framing, General:

1. Provide framing members of sizes and on spacings shown. Frame openings as shown. If specific details not shown, comply with recommendations of NFPA, "Manual for House Framing" and AITC "Standard Construction Details". Do not splice structural members between supports.

E. Rough Hardware:

1. Securely attach rough carpentry Work to substrate by anchoring and fastening as shown and as required by recognized standards, and as approved by the Engineer.

2. Provide all rough or framing hardware, such as nails, screws, anchors, hangers, clips, inserts, miscellaneous fastenings, and similar items of best quality and of proper size and kind to adequately secure Work together and in place, in rigid and substantial manner.

3. Use common wire nails, except as otherwise shown. Select fasteners of size that will not penetrate through members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

4. Secure rough carpentry to solid masonry with 1/2 inch diameter bolts and epoxy anchorage system (see Section 03250 for information) or other approved manner, with fastenings not more than 32 inches o.c.

5. Fasteners, used in exterior locations, shall be aluminum, galvanized steel, or approved non-ferrous metal and shall be compatible with materials being fastened. Fasteners used with preservative treated wood shall be hot-dipped, zinc-coated.

6. Countersink bolts in nailers and other rough woodwork and include washers and nuts. Cut bolts off flush with surfaces and peen as required to receive finished Work.

7. Inserts to secure wood nailers to concrete shall be threaded malleable iron with 3/8" diameter bolts of length to allow for countersinking. Locate at end of each nailer and at intervals not exceeding 30" on center.

END OF SECTION 06 10 00
ROUGH CARPENTRY

SECTION 07 10 00

WATER PROOF COATING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.02 WORK INCLUDED

A. Furnish all labor, materials, and equipment to install water proof coatings on the south wall of the New York Collection Building.

1.03 RELATED WORK

A. Work in other Sections related to Water Proof Coating and to be performed by the same contractor as the work of this section:

1. Section 07 90 00 Building Sealants

1.04 QUALITY ASSURANCE

A. Water proof coating Work shall be performed by firm specializing in special coatings and having at least two years of experience in application of types of water proofing required.

B. Application of water proof coating shall be made by manufacturer's authorized applicator or under direct supervision of representative of manufacturer as acceptable to Architect.

1.05 SUBMITTALS

A. Submit before beginning of Project, experience record of applicator responsible for water proof coating Work.

B. Submit color charts for Owner's selection of color.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to site in original sealed containers with seals unbroken and labels intact bearing manufacturer's name and brand name of product.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.07 WARRANTY

A. Furnish Owner with written, total responsibility warranty that surfaces coated with water proof coating will be free of water penetration, chalking or other weathering

deterioration, blistering, adhesive or cohesive failure for a five (5) year period from date of acceptance of Work.

B. For duration of guarantee, provide at no cost to Owner any labor and materials required to recoat defective areas with water proof coating.

PART 2 PRODUCTS

2,.01 MATERIALS

A. Waterproof Coating

1. Hydrolastic with Hydrosealer Bonding Coat by Devoe
2. Thorolastic with Thoro Primer CM by Thoro System Producers
3. or Approved Equivalent

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect surfaces to receive water proof coating and report immediately in writing to Architect any deficiencies in surface which render it unsuitable for proper execution of Work. Proceed with Work only after deficiencies have been acceptably remedied.

3.02 PREPARATION

A. Protect all adjoining Work and property from spillage or blow-over of water proof coating:

1. Pressure wash exterior walls.
2. Cover adjoining or nearby surfaces of aluminum and glass if there is any possibility of water proof being deposited on their surfaces.
3. Cover live plant materials with drop cloths.
4. Immediately clean any spillage of water proof on adjoining surfaces according to manufacturer’s recommendations.

3.03 INSTALLATION

A. Apply water proof coating in strict accordance with manufacturer's specifications, including those which relate to air and surface temperature requirements.

B. Complete, cure, and clean all related Work before applying water proof coatings. Repair damage to uncured materials resulting from applying water proof coatings at no cost to Owner.

C. Apply one coat of primer and two coats of water proof coating.

END OF SECTION 07 10 00
WATER PROOF COATING

SECTION 07 11 13

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cold applied asphalt dampproofing for concrete surfaces.

B. Related Sections:

1. Division 01: Administrative, procedural, and temporary work requirements.

1.02 REFERENCES

A. ASTM International (ASTM):

1. D1187 – Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
2. D4258 – Standard Practice for Surface Cleaning Concrete for Coating.
3. D4261 – Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.
4. E96 – Standard Test Method for Water Vapor Transmission of Materials.

1.03 SUBMITTALS

A. Submittals for Review:

1. Product Data: Include product description and performance characteristics.

B. Sustainable Design Submittals:

1. Regional Materials.

1.04 DELIVERY, STORAGE AND HANDLING

A. Store materials in enclosed space, protected from weather and direct sun.

B. Maintain temperature range in storage area of 40 to 90 degrees F.

1.05 PROJECT CONDITONS

A. Do not apply at ambient or surface temperatures below 40 degrees F, nor during inclement weather.

B. Substrate: Cured minimum seven (7) days.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. BASF Building Systems. (www.chemrex.com)
2. W.R. Meadows, Inc. (www.wrmeadows.com)
3. Tamms Industries. (www.tamms.com)

B. Substitutions: Under provisions of Division 01.

2.02 MATERIALS

A. Asphalt Emulsion:

1. Type: ASTM D1187, _____ based, _____, consisting of refined asphalt, emulsifiers, and clay fillers.

2. Water vapor permeance: Maximum 1.0 grams/100 square inches/24 hours, tested to ASTM E96.

2.03 ACCESSORIES

A. Flashing Sheet: Minimum 32 mil thick rubberized asphalt laminated to HDPE film, release paper facing, self adhering.

B. Mastic: ASTM D1187, fibrated, consisting of refined asphalt, non asbestos fibers, emulsifiers, and clay fillers, trowel grade.

C. Reinforcing Fabric: Woven glass fiber type.

D. Patching Compound: Type recommended by dampproofing manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces; remove loose and foreign matter that could impede adhesion or performance of dampproofing.

B. Seal cracks and holes less than ¼ inch wide with mastic and reinforcing fabric. Extend minimum 2 inches beyond edges of crack or hole.

C. Fill cracks over ¼ inch in width with patching compound.

D. Dampen dry surfaces before applying dampproofing.

3.02 APPLICATION

A. Apply emulsion by roller or spray to continuous and uniform coverage.

B. Apply at minimum rate of 75 square feet per gallon, as directed by manufacturer.

C. Allow to dry until tack free.

D. Seal to door and window frames, around penetrations, and at perimeter with flashing sheet. Press to full bond with substrate without voids, wrinkles, bridging, or fishmouths.

3.03 FIELD QUALITY CONTROL

A. Prior to applying veneer, inspect surfaces for voids and damage.

B. Repair voids and damaged areas with an additional coat of emulsion.

END OF SECTION 07 11 13
BITUMINOUS DAMPPROOFING

SECTION 07 17 00

BENTONITE PANEL WATERPROOFING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions, and Division 1 General requirements, apply to the work of this section.

1.02 WORK SUMMARY

A. The work of this section includes, but is not limited to the furnishing and installing of the following materials, per project specifications and drawings, or as directed by bentonite waterproofing manufacturer, to cast-in-place concrete foundation walls:

1. Sodium bentonite waterproofing membrane with all applicable accessory products.

2. Prefabricated drainage composite and Base Drain.

1.03 RELATED SECTIONS

A. Other specification Sections which directly relate to the work of this section include, but are not limited to, the following:

1. Division 2: Subsurface and Geotechnical Investigations
2. Division 3: Waterstops
3. Division 5: Expansion Joint Products
4. Division 7: Joint Treatment/ Sealants, Flashing and sheet metal, and Insulation
5. Division 22: Mechanical Penetrations
6. Division 26: Conduit and other Electrical Penetrations
7. Division 31: Earthwork, Excavation and Fill
8. Division 33: Geocomposite Foundation Drainage

1.04 SYSTEM DESCRIPTION

A. Provide bentonite waterproofing and prefabricated drainage composite system to prevent the passage of liquid water and install without defects, damage or failure. Waterproofing shall consist of biodegradable corrugated kraft board containing one pound (0.45 kg) per square foot (0.1 sq m) of granular Volclay sodium bentonite.

1.05 SUBMITTALS

A. General: Prepare and submit specified submittals in accordance with “Conditions of the Contract” and Division 1 Submittals Sections.

B. Product Data: Submit manufacturer’s product data, with complete general and specific installation instructions, recommendations, and limitations.

C. Product Samples: Submit representative samples of the following for approval:

1. Volclay Panel membrane waterproofing

2. Aquadrain 15XP and Aquadrain 100BD prefabricated drainage composites

D. Contractor Certificate: At time of bid, submit written certification that installer has current Approved Applicator status with waterproofing material manufacturer.

E. Waterproofing Material Warranty: At time of bid, submit a sample copy of the Manufacturer's Waterproofing Material Warranty complete with all coverage, limitations, and conditions.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Installing company should have at least three (3) years experience in work of the type required by this section, who can comply with manufacturer's warranty requirements, and who is an Approved Applicator as determined by waterproofing/drainage system manufacturer.

B. Manufacturer Qualifications: Bentonite waterproofing and all accessory products shall be provided by a single manufacturer with a minimum of thirty (30) years experience in the direct production and sales of bentonite waterproofing systems. Manufacturer shall be capable of providing field service representation during construction, approving an acceptable installer, recommending appropriate installation methods of the bentonite waterproofing and prefabricated drainage system applied.

C. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field installation to establish procedures to maintain required working conditions and to coordinate this work with related and adjacent work. Verify that final waterproofing and waterstop details comply with waterproofing manufacturer's current installation requirements and recommendations. Pre-con meeting attendees should include representatives for the owner, architect, inspection firm, general contractor, waterproofing contractor, concrete contractor, excavating/backfill contractor, and mechanical and electrical contractors if work penetrates the waterproofing.

D. Materials: Obtain bentonite panel waterproofing and prefabricated drainage materials from a single manufacturer to assure material compatibility.

E. Inspection: Manufacturer's representative shall inspect waterproofing installation periodically during application to verify that waterproofing has been installed in accordance with manufacturer's guidelines and recommendations.

F. Water Sample Test: Project site water sample supplied to manufacturer by waterproofing contractor to determine type of bentonite system (standard sodium bentonite or contaminate resistant (CR) sodium bentonite) to be utilized on the project. Manufacturer shall conduct test free of charge. Contractor is responsible for collection and shipment of 64-fluid ounces (2-liters) of actual site water. Water should be shipped in uncontaminated, sealed plastic container to: CETCO, 2870 Forbs Avenue, Hoffman Estates, IL 60192, Attn: BMG Field Services. Also

provide project name, city and state along with return address to forward test results.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling: Deliver materials in factory sealed and labeled packaging. Sequence deliveries to avoid delays, while minimizing on-site storage. Handle and store following manufacturer's instructions, recommendations and material safety data sheets. Protect from construction operation related damage, as well as, damage from weather, excessive temperatures and prolonged sunlight. Remove damaged material from site and dispose of in accordance with applicable regulations.

B. Storage: Do not double-stack pallets during shipping or storage. Protect waterproofing materials from moisture, excessive temperatures and sources of ignition. Provide cover, top and all sides, for materials stored on-site, allowing for adequate ventilation.

1.08 PROJECT CONDITIONS

A. Substrate Condition: Proceed with work only when cast-in-place concrete wall construction and surface preparation work is complete and in condition to receive waterproofing system.

B. Weather Conditions: Perform work only when existing and forecasted weather conditions are within the guidelines established by the manufacturer of the waterproofing materials. Do not apply waterproofing materials into standing water or over ice.

1.09 WARRANTY

A. Waterproofing Material Warranty: Upon completion and acceptance of the work required by this section, the waterproofing materials manufacturer will provide a written five (5) year material warranty. Issuance of Manufacturer's Material Warranty requires the following: (1) Manufacturer's Approved Applicator to install bentonite panel waterproofing system and prefabricated drainage composite. (2) In Section 3 work, Waterstop-RX must be installed in all applicable horizontal and vertical concrete construction joints and around applicable penetrations. Manufacturer's material warranty shall be independent from any other warranties made by the Contractor under requirements of the Contract Documents and may run concurrent with said warranties.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Provide bentonite panel waterproofing with biodegradable kraft board container and applicable accessories as manufactured by Colloid Environmental Technologies Company (CETCO), 2870 Forbs Avenue, Hoffman Estates, IL 60192. Phone: (800) 527-9948; (847) 851-1800; website: http://www.cetco.com/bmg.

B. Products of other manufacturers will be considered.

2.02 MATERIALS

A. VOLCLAY BENTONITE PANEL WATERPROOFING

1. Volclay type 1 Panels: Volclay Type 1 Panels consist of 1 lb. (0.45 kg) per square foot of specially treated granular sodium bentonite contained inside a biodegradable, corrugated kraft board measuring 48” x 48” x 3/16” thick (1.2m x 1.2m x 0.47cm).

B. ACCESSORY WATERPROOFING PRODUCTS: All accessory waterproofing materials shall be provided by the bentonite waterproofing manufacturer or shall have manufacturer’s written approval for substitution.

1. Bentoseal®: Trowel grade sodium bentonite compound used as a detailing mastic around penetrations, corner transitions and grade terminations.

2. Hydrobar Tubes: 2” (50 mm) diameter x 2’ (60 cm) long, water soluble tube container filled with granular sodium bentonite.

3. Waterstoppage®: 50 lbs. (22.7 kg) bag of granular Volclay sodium bentonite.

4. Termination Bar: Min. 1” (25 mm) wide aluminum bar with pre-punched holes on 12” (300 mm) centering for fastening.

5. CETSEAL: Single-component polyether general sealant and adhesive.

6. GF-40SA: Self-adhering flashing membrane used for grade and thru-wall detailing.

C. BASE AND SHEET DRAINAGE COMPOSITE

Aquadrain® drainage composite by CETCO shall be used where specified to promote positive drainage. Use base drain accessory connectors and outlets as required.

1. Aquadrain® 15XP – 4-ft by 52-ft roll of a three-dimensional polypropylene drainage core with a nonwoven geotextile adhered to one side to allow water passage while restricting soil particles. Composite includes a thin polyethylene sheet on the back of the drainage core.

    a. Compressive Strength: 15,000 psf (718 kPa)
    b. Water Flow Rate: 20 gpm/ft (251 l/m/m)
    c. Thickness: 7/16” (11 mm)

2. Aquadrain® 100 BD Base Drain – 1” (25 mm) thick x 12” (300 mm) high base drain composite designed to collect water from sheet composite drainage and then discharge the water to proper sump system or gravity to daylight.

    a. Compressive Strength: 10,000 psf (457 kPa)
    b. Water Flow Rate: 97 gpm/ft (1,197 l/m/m)
    c. Thickness: 1” (25 mm)

PART 3 EXECUTION

A. Comply with contract documents and manufacturer's product data, including product application and installation instructions.

3.01 SUBSTRATE INSPECTION AND CONDITIONS

A. The installer shall examine conditions of substrates and other conditions under which this section work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected and are acceptable for compliance with manufacturer's warranty requirements. General substrate conditions acceptable for the waterproofing installation are listed below. For conditions not covered in this Section, contact the waterproofing manufacturer for guidance.

B. CONCRETE WALLS: Cast-in-place concrete to receive waterproofing shall be of sound structural grade with a smooth finish, free of debris, oil, grease, laitance, dirt, dust, or other foreign matter which will impair the performance of the waterproofing and drainage system and which do not comply with manufacturer's warranty requirements. Volclay Panels can be installed on green structural concrete as soon as the forms are removed. There is no product limitation regarding a minimum concrete curing time requirement for Volclay Panels to be installed over structural concrete. Manufacturer recommends gaining instructions from project structural engineer regarding any site specific concrete curing time requirement. Do not apply Volclay Panel waterproofing over lightweight insulating concrete.

1. Form fins, ridges, and other protrusions should be level and smooth with monolithic concrete surface. Honeycombing, aggregate pockets, tie-rod holes and other voids should be completely filled with non-shrink cementitious grout and level with monolithic concrete wall surface.

2. All expansion joints should receive applicable expansion joint sealant product manufactured by others prior to the installation of the Volclay Panel Waterproofing System. Expansion joint material is the primary seal at the expansion joint and the expansion joint material manufacturer is responsible for water tightness of the joint.

NOTE: Related work to be completed under Division 3. Waterstop-RX shall be installed in all applicable vertical and horizontal concrete construction cold pour joints and around applicable penetrations and structural members secured with CETSEAL. Refer to Waterstop-RX Product Manual for further installation procedures and guidelines.

3.02 SURFACE PREPARATION

A. Remove dirt, debris, oil, grease, cement laitance, or other foreign matter which will impair or negatively affect the performance of the waterproofing and drainage system.

B. Protect adjacent work areas and finish surfaces from damage or contamination from waterproofing products during installation operations.

3.03 GENERAL INSTALLATION GUIDELINES

A. Install Volclay Panels with the printed side facing installer and the print oriented horizontally. Turn Panel with print vertically oriented when transitioning around inside and outside wall corners.

B. Prevent bentonite waterproofing products from hydrating before material is contained with backfill. When threat of rain is imminent, installed bentonite products not already contained by backfill should be covered with polyethylene sheeting to decrease the chance of hydration. Remove polyethylene prior to overburden or backfill operations. After any precipitation, standing water should be pumped away from waterproofing as soon as possible.

C. Hydrostatic head conditions greater than 33 feet (10 m) require the installation of two layers of Volclay Panels per Section 3.05. Only a single layer of Volclay Panels is required for hydrostatic pressure of 0-33 feet (0-10 m). For hydrostatic conditions exceeding 33 feet of head pressure, install two layers of Volclay Panels as described below.

D. Expansion Joints: Volclay panel waterproofing is not an expansion joint filler or sealant, but may be used as an expansion joint cover over a properly installed expansion joint material placed during substrate preparation. To use Volclay Panels as an expansion joint cover, trowel 1/8" (3 mm) thick, 6" (150 mm) wide layer of Bentoseal centered over expansion joint. Install a 24" (60 cm) wide Panel strip centered over the expansion joint. Then install the main Volclay Panel course.

3.04 BACKFILLED CAST-IN-PLACE CONCRETE WALLS

A. Trowel Bentoseal over all concrete construction joints 1/8" (3 mm) thick by 3" (75 mm) wide. Form Tie holes or recesses shall be completely filled with non-shrink cementitious grout. Trowel Bentoseal 1/8" (3 mm) thick over each grouted form tie hole.

B. Trowell ¾" (18 mm) continuous fillet of Bentoseal in all inside corner transitions.

C. Starting at a wall base corner, bend Volclay Panel along 1/3 panel "Starter Line" (printed on panel) and install with the kraft board corrugations and print vertically oriented. Cut the Panel at the bottom edge of the "Starter Line" so that the Panel can be extended 6" (150 mm) onto the footing. Secure Panels with washer-head fasteners along each edge. After installing corner Panel, install all succeeding Panels with kraft board corrugations and print horizontally oriented – continuing Panel onto footing minimum 6" (7.5 cm). Overlap all adjoining edges minimum 1-1/2" (38 mm). When applicable, the base Panel course shall overlap the underslab waterproofing a minimum 6" (150 mm) to form a continuous waterproofing layer.

D. Stagger vertical Panel overlap joints of succeeding courses by folding the next courses corner Panel on the 2/3 panel "Lap Line" (printed on panel) and install overlapping lower Panel course minimum 1-1/2" (38 mm). After installing corner Panel, install all succeeding Panels with kraft board corrugations and print horizontally oriented – overlapping adjoining edges minimum 1-1/2" (38 mm).

E. Penetration. On flat surface cut Panel to fit around penetration. Immediately seal cut Panel edge by applying water with cloth or sponge prior to panel installation. After Panel is installed around penetration, trowel ¾" (18 mm) thick fillet of

Bentoseal around the penetration and extending onto Panel 1-1/2" (38 mm) at a 1/8" (3 mm) minimum thickness.

E1. Multiple Penetrations. Trowel ½" (13 mm) thick layer of Bentoseal covering entire area between penetrations and extend layer outside of penetration area minimum 3" (75 mm) to allow Panels to overlap. At base of each penetration apply ¾" (18 mm) fillet of Bentoseal over the main Bentoseal layer. Cut Panels and overlap Bentoseal layer a minimum 1-1/2" (38 mm).

F. Continue Panels up to grade detail. Terminate Panels 12" (30 cm) below finished grade elevation secured with washer-head fasteners maximum 12" (300 mm) on center to exterior of concrete wall. Per manufacturer's detail for specific project condition(s) install GF-40SA grade flashing to primed concrete substrate with bottom edge overlapping top edge of Volclay Panels minimum 4" (100 mm). Overlap all roll ends a minimum 4" (100 mm) to form a continuous flashing. Height of flashing shall be per project details and specifications. Install a rigid termination bar along the top edge of GF-40SA; fastened maximum 12" (300 mm) on center. Complete grade termination detail with tooled bead of CETSEAL along the top edge, at all penetrations through the flashing, and all exposed overlap seams.

G. Before backfilling, lay Hydrobar Tubes against the base of the first Volclay Panel course at the wall/footing transition. Hydrobar Tubes should be positioned end-to-end forming a continuous line. Manually place and tamp a shovel of backfill over Hydrobar Tubes to hold them in position prior to main backfill operation.

H. Repair any small Panel damage by applying a ½" (13 mm) thick layer of Bentoseal. Repair any large Panel damage by placing a new panel into position.

I. Install Aquadrain prefabricated drainage composite over Panel system. Refer to Part 3.06, for Aquadrain installation instructions.

Note: Do not use Volclay Panels on masonry block walls. Consult CETCO for specific product(s) and installation guidelines for masonry block foundation walls.

3.05 HYDROSTATIC HEAD IN EXCESS OF 33 FEET (10 METERS)

A. Install two (2) Panel layers. Surface preparation, detailing, and terminations remain the same as with a single Panel layer application.

B. Install first Panel layer with edges butted, not overlapped. Fasten butted vertical Panels securely to concrete surface with washer-headed fasteners.

C. The second Panel layer is placed directly over the first Panel layer so that the seams of the two Panels layers stagger and do not match. The second Panel layer should mask the seams of the first Panel layer. Again, butt the second Panel layer edges together – do not overlap the Panel edges.

3.06 PREFABRICATED DRAINAGE COMPOSITE INSTALLATION

A. At the base of the wall, place Aquadrain 100BD (100BD) base-drain horizontally oriented with the open core side up and the 2" (50 mm) flap of fabric side tight against the wall over the previously installed Volclay Panel waterproofing using wash-head mechanical fasteners or general construction adhesive. The 2" fabric flap along the top edge of 100BD should be tightly secured against the wall. Use

100BD accessory fittings, as required, to form a continuous installation. Install 100BD discharge outlet fittings to connect to discharge pipes as required for the project.

B. Install the bottom course of Aquadrain 15xP sheet drainage (plastic core side against the wall) with the 15XP bottom core edge in contact with open top core edge of 100BD. Secure sheet drain to wall with washer-head fasteners. Secure extra fabric flap of 15XP extending down the top front edge of 100BD to prevent the passage of soil into the core at the connection.

C. Install subsequent courses of Aquadrain 15XP sheet drainage in a shingle overlap style to finished grade or as shown on the project drawings. Prior to subsequent course, seal top and side core edges by tucking the products extra fabric edge flap behind the core before securing with washer-head fasteners. Install drainage sheet panels overlapped, bottom edge of high course installed to the outside of the lower course to shed water like a roof shingle. Seal all outward overlap core edges by securing extra fabric flap with tape or general construction adhesive to filter fabric of previously installed sheet.

D. Around penetrations and other details, cut sheet drainage composite to fit and wrap extra filter fabric around open core edge to prevent soil from entering core.

E. At the top of the sheet drain installation, wrap the filter fabric flap behind the exposed top core edge to prevent intrusion of soil into the core and secure sheet drain to wall with termination bar fastened 12” (300 mm) on center.

3.07 INSULATION

A. Always apply Volclay Panel waterproofing directly to properly prepared structural concrete substrates. Insulation, if used, should be applied over the waterproofing and drainage. Do not apply Volclay Panel waterproofing over lightweight insulating concrete.

3.08 PROTECTION COURSE

A. Compactable soil backfill, free of debris and gravel does not require a protection course. If backfill contains debris or gravel, then a protection course is required. Consult manufacturer when special conditions exist. Aquadrain prefabricated drainage composite may double function as a protection course. Do not use expanded polystyrene (bead board) as a protection course.

3.09 BACKFILL EXCAVATED CAST-IN-PLACE CONCRETE WALLS

A. Closely coordinate Volclay Panel installation with Backfill conducted under Division 31 work. Care should be used during backfill operation to avoid damage to the waterproofing system. Follow generally accepted practices for backfilling and compaction. Backfill should be added in 6” to 12” (150 – 300 mm) lifts and compacted to a minimum 85% Modified Proctor density. Protection course required with gravel backfill. Limit gravel backfill to <3/4” (18 mm) angular aggregate with fines.

3.10 CLEAN UP

A. Clean areas where adjacent finished surfaces are soiled by work of this Section. Remove all tools, equipment and remaining product on-site. Dispose of section work debris and damaged product following all applicable regulations.

END OF SECTION 07 17 00
BENTONITE PANEL WATERPROOFING

SECTION 07 21 13

BOARD INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. At perimeter of foundation

B. Related Sections:

1. Division 01: Administrative, procedural, and temporary work requirements.

1.02 REFERENCES

A. ASTM International (ASTM):

1. C578 – Standard Specification for Rigid Cellular Polystyrene Thermal Insulation.

2. C1301 – Standard Test Method for Estimating the Long-Term Change in Thermal Resistance of Unfaced Rigid Closed Cell Plastic Foams by Slicing and Scaling Under Controlled Laboratory Conditions.

3. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

4. E96 – Standard Test Method for Water Vapor Transmission of Materials.

5. E136 – Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.03 SUBMITTALS

A. Quality Control Submittals:

1. Certificates of Compliance: Certification from an independent testing laboratory that insulation meets fire hazard classification requirements.

1.04 QUALITY ASSURANCE

A. Fire Hazard Classification:

1. Noncombustible, tested to ASTM E136.

2. Flame spread/smoke developed rating of 25 or less, tested to ASTM E84.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store insulation in clean, dry, sheltered area, off ground or floor, until used. Protect against wetting and moisture absorption.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Dow Chemical Co. (www.dowbuildingmaterials.com)
2. Owens Corning. (www.owenscorning.com)
3. Certain Teed. (www.certainteed.com)

2.02 MATERIALS

A. Foundation Board Insulation:

1. ASTM C578, Type closed cell extruded polystyrene foam.
2. Minimum compressive strength: 25 PSI.
3. Thermal resistance: Minimum R value of 5 per inch, calculated in accordance with ASTM C1303.
4. Water vapor permeance: Maximum 1.01 perms, tested to ASTM E96.
5. Groove underside of boards in one direction to achieve water drainage.
6. Provide tapered boards to achieve slopes indicated.

2.03 ACCESSORIES

A. Adhesive: Type recommended by insulation manufacturer.

B. Tape: Minimum 4 inches wide, pressure sensitive, waterproof, compatible and accepted by insulation board manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Substrate:

1. Remove protrusions flush with adjacent surface.
2. Remove dirt, dust, oil, grease, and other materials that could impair adhesion.

3.02 INSTALLATION AT FOUNDATION

A. Apply adhesive in continuous beads.

B. Install boards on foundation wall horizontally.

C. Place boards in a method to maximize contact bedding.

D. Stagger side joints.

E. Butt edges and ends to adjacent boards and at perimeter.

F. Extend boards over control joints, unbonded to foundation, 2 inches on one side of joint.

G. Cut and fit insulation tight to protrusions or interruptions to the insulation plane.

END OF SECTION 07 21 13
BOARD INSULATION

SECTION 07 21 50

CLOSED CELL SPRAY FOAM (SPF) INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. SPF insulation and vapor retarder in exterior stud wall assemblies.

2. SPT insulation at entire underside of roof sheathing.

3. As required to achieve proper air infiltration, seal at wall / ceiling and wall / floor joints to comply with LEED-For-Homes requirements.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 07 Section “Rigid Insulation” for insulation installed as part of exterior foundation walls.

2. Division 07 Section “Batt Insulation” for insulation installed as part of sound insulation for interior partitions.

3. Division 07 Section “Loose-Fill Insulation” for insulation installed as part of attic insulation system.

4. Division 09 Section “Painting” for Level 3 vapor retarder.

1.03 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data: for each type of insulation product specified.

1.04 INFORMATIONAL SUBMITTALS

A. Material Safety Data Sheet: Submit Material Safety Data Sheet complying with OSHA Hazard Communication Standard, 29 CRF 1910 1200.

B. Product test reports.

C. Research/evaluation reports.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable test and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.

2. Fire-Resistance Ratings: ASTM E 119.

3. Combustion Characteristics: ASTM E 136.

4. R factor of R6.5 to R7 per inch.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered in their original, tightly sealed containers.

B. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

C. Keep temperature of the chemicals above 70 deg F for several days prior to use. Cold chemicals can cause pump cavitation and, therefore, incorrect metering. Storage temperatures should not exceed 90 deg F. Do not store in direct sunlight. Keep drums tightly closed when not in use and under dry gas pressure of 2-3 psi after they have been opened. Store per manufacturer's requirements.

1.07 SEQUENCING AND SCHEDULING

A. SPF insulation is applied after the perimeter wall is in place, windows and doors installed, and rough-in plumbing and electrical inspections are complete.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. NCFI Polyurethanes, Division of BMC

2. Johns Manville

3. Dow Spray Foam

B. Requests for substitutions will be considered in accordance with provisions of Division 01.

2.02 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.

B. Polyurethane Closed Cell Insulation:

1. Basis of Design: NCFI Insulstar spray-in-place closed cell polyurethane foam insulation meeting UL Fire Resistivity Design U391.

2.03 Level 3 Vapor Retarder is the latex wall paint specified elsewhere.

2.04 ACCESSORIES

A. Joint Filler Foam: Hilti CF 124 Filler Foam or equivalent.

B. Moisture Detection Paper (MDP) strips: produced by NCFI Polyurethanes or equivalent.

C. Caulk: Silkaflex 1a: Single Component polyurethane or equivalent.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

B. All surfaces to be sprayed must be dry, clean, and secure. Remove sawdust and other debris from areas to be sprayed by vacuuming with a shop vacuum. Check surfaces with Moisture Detection Paper (MDP) to verify dryness. All metal to which foam is to be applied must be free of oil, grease, rust, etc.

C. Mast off all areas not to receive spray foam with masking tape and plastic sheeting. Apply release agent to stud facing to facilitate removal of foam.

3.03 INSTALLATION OF SPF INSULATION

A. Comply with insulation manufacturer’s written instructions applicable to products and application indicated.

B. Apply self-supported, spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make it even with studs by using method recommended by insulation manufacturer.

C. Apply spray foam using a "picture framing" technique: apply a cant of foam between the exterior sheathing and the inner stud surface. Then spray-apply the required thickness of foam against the sheathing. For a nominal thickness of ½ inch, apply in one pass. For filing the stud wall cavity, apply the foam in two or more passes. Maximum layer or thickness of each pass shall be 2 inches.

D. Accessory Application:

1. Use batt filler foam and caulk for filling perimeter window and door shim spaces, crevices in exterior wall and roof, sound insulation in interior partitions, and in interior locations as indicated, including electrical raceways and sill plates.

3.04 PROTECTION

A. General: Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.05 CLEAN UP

A. Clean off all overspray and overfill from the interior stud facing. For fully filled stud cavities, shave off the foam face to provide a surface flush with the stud for drywall installation. Remove all masking materials.

END OF SECTION 07 21 50
CLOSED CELL SPRAY FOAM (SPF) INSULATION

SECTION 07 54 23

THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thermoplastic Polyolefin Membrane Roofing

B. Membrane Flashings

C. Metal Flashings

D. Roof Insulation

1.02 RELATED SECTIONS

A. Section 06 10 00 – Rough Carpentry: Roof blocking installation and requirements.

B. Section 07 21 10 – Loose Fill Insulation.

C. Section 07 21 50 – Closed Cell Foam Insulation.

D. Section 22 – Plumbing Specialties: Roof drains, scuppers, gutters and downspout installation and requirements.

1.03 REFERENCES

A. American Society of Civil Engineers (ASCE) – ASCE 7 – Minimum Design Loads for Buildings and Other Structures, Current Revision.

B. ANSI/SPRI WD-1 “Wind Design Standard for Roofing Assemblies”.

C. ASTM International (ASTM):

1. ASTM C 208 – Standard Specification for Cellulosic Fiber Insulating Board

2. ASTM C 1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

3. ASTM D 412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension

4. ASTM D 1079 – Standard Terminology Relating to Roofing, Waterproofing, and Bituminious Materials

5. ASTM D 6878 – Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing

6. ASTM E 96 – Standard Test Methods for Water Vapor Transmission f Materials

D. Factory Mutual (FM Global):

1. Approval Guide.

a. Factory Mutual Standard 4470 – Approval Standard for Class 1 Roof Covers
b. Loss Prevention Data Sheets 1-28, 1-29

E. International Code Council (ICC):

1. International Building Code (IBC)

F. National Roofing Contractors Association (NRCA) – Low Slope Roofing and Waterproofing Manual, Current Edition

G. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) – Architectural Sheet Metal Manual

H. Underwriters Laboratories (UL):

1. TGFU R1306 – “Roofing Systems and Materials Guide”

2. UL-790 – Standard Test Method for Fire Tests of Roof Coverings

I. ANSI / ASHRAE / IESNA Standard 9.1 (2007): Energy Standard for Buildings Except Low-rise Residential Buildings.

1.04 DESIGN CRITERIA

A. Wind Uplift Performance:

1. Roof system designed to withstand wind uplift forces as calculated using the current revision of ASCE-7.

B. Fire Resistance Performance:

1. Roof system will achieve a UL Class A rating when tested in accordance with UL-790.

C. Thermal Performance: Roof system will achieve a minimum R value not less than 60. (This is accomplished using insulation.)

D. Drainage: Provide a roof system with positive drainage where all standing water dissipates within 48 hours after precipitation ends.

E. Building codes:

1. Roof system will meet the requirements of all federal, state and local code bodies having jurisdiction.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

C. Detail Drawings:

1. Submit approval plan, section, elevation or isometric drawings which detail the appropriate methods for all flashing conditions found on the project.

2. Coordinate approved drawings with locations found on the Contract Drawings.

D. Selection Samples: For each finish product specified, two complete sets of chips representing manufacturer's full range of available colors, membranes, and thicknesses.

E. For each finish product specified, two samples, minimum size 4 inches (100 mm) square representing actual product, color, and patterns.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of fifteen (15) years experience.

B. Installer Qualifications:

1. All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.

2. Installer must be capable of extending the Manufacturer's Labor and Materials guarantee.

3. Installer must be capable of extending the Manufacturer's No Dollar Limit guarantee.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation, installation techniques and workmanship.

1. Finish areas designated by Architect.

2. Do not proceed with remaining work until workmanship, color, and sheen are approved by architect.

3. Refinish mock-up area as required to produce acceptable work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

C. Material Safety Data Sheets (MSDS) must be on location at all times during the transportation, storage and application of materials.

D. When loading materials onto the roof, the Carlisle Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.

1.08 PROJECT CONDITIONS

A. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.

B. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.

C. Provide protection, such as ¾ inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.

D. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.

E. New roofing shall be complete and weather tight at the end of the work day.

F. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

1.09 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's Total System warranty, outlining its terms, conditions, and exclusions from coverage.

1. Duration: 15 years.

2. Coverage to be extended to include accidental punctures in accordance with terms stated in the Warranty document.

3. Coverage to be extended to include hail damage in accordance with terms stated in the Warranty document.

B. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.

PART 2 PRODUCTS

2.01 SCOPE / APPLICATION

A. Roof System: Provide a waterproof roof system, capable of withstanding uplift forces as specified in the Design Criteria article of this section.

1. Membrane Attachment: Fully Adhered.

B. Base Flashing: Provide a waterproof, fully adhered base flashing system at all penetrations, plane transitions and terminations.

C. Insulation: Provide a roof insulation system beneath the finish membrane.

2.02 INSULATION

A. Polyisocyanurate HP-H: Tapered rigid board with fiber reinforced facers on both sides, meeting or exceeding the requirements of ASTM C 1289. Carlisle HPH.

1. Compressive Strength: 20 psi (138 kPa).

2. Density: 2 lb per cubic foot (24 kg/cu m) minimum.

2.03 INSULATION ADHESIVE

A. Sure-Seal FAST 100 or 100 LV Adhesive: A spray or extruded applied, two-component polyurethane, low-rise expanding foam adhesive used for attaching approved insulations to compatible substrates (concrete, cellular lightweight insulating concrete, gypsum, cementitious wood fiber, wood or steel) or existing smooth or gravel surfaced BUR, modified bitumen or cap sheets.

2.04 THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE

A. Membrane:

1. Color: White.

2. Membrane Thickness: 45 mil nominal.
    a. Thickness over Scrim: 0.015 inches (0.38mm).
    b. Breaking Strength (ASTM D 751): 225 lbf/in (1 kN/m) minimum.
    c. Tear Resistance (ASTM D 751); 55 lbf/in (245 N/m) minimum.
    d. Elongation (ASTM D 751); 25 percent.

3. Field Sheet Dimensions:
    a. Width: 6 feet (1.8 m) maximum.

4. Performance:
    a. Breaking Strength: FB 100 – 300 lbf (1.3 kN) minimum / FB 115 – 400 (1.8 kN) minimum.
    b. Tear Strength: 55 lbf/in (245 N/m) minimum.
    c. Elongation: 25 percent.

B. Inside Corners: Pre-molded corner flashing for inside corners. 60 mil thickness. Color to match membrane. Special colors require custom fabrication process.

C. Outside Corners: Injection molded corner used for flashing outside corners. 60 mil thickness. Color to match membrane. Special colors require custom fabrication process.

D. TPO T-Joint Covers: Injection molded 60 mil thick TPO formed into a 4.5 inch (114mm) diameter circle used to seal step-offs at splice intersections. Color to match membrane. Special colors require custom fabrication process.

E. TPO Curb Wrap Corners: Pre-fabricated corner flashings made from 45 mil thick reinforced Sure-Weld membrane. 6 inch (152 mm) wide base flange and a 12 inch (305 mm) overall height. Sizes available to fit curbs up to 6 foot by 6 fot (1828 x 1828 mm) in size. Color to match membrane. Gray, tan and special colors require custom fabrication process.

F. Molded Pipe Seals: A pre-molded flashing and clamping ring used for pipe penetrations. Available for 0.75 inch to 8 inch (19 – 203.2 mm) diameter pipes. Color to match membrane. Special colors not available

G. Split Pipe Seals: Pre-fabricated flashing consisting of 45 mil thick reinforced Sure-Weld Membrane for pipes 1 inch to 6 inch (25.4 – 152.4 mm) in diameter. A split (cut) and overlapped tab is incorporated to allow the pipe seal to be opened and wrapped around the pipe when it is not possible to pull a standard pipe flashing over a round penetration. Gray, tan and special colors require custom order fabrication. Custom sizes available on a special order basis.

H. TPO Molded Sealant Pockets:

1. A two-piece, interlocking injection molded, flexible pocket with a rigid polypropylene vertical wall and pre-formed deck flanges. Color to match membrane. Special colors not available.

2. Used with Thermoplastic One-Part Pourable Sealer as specified in this section for waterproofing pipe clusters or other odd shaped penetrations. The removable built-in extension legs allow the oval pocket to adjust from 7.5 inches to 12 inches (191 mm – 305 mm) in length while maintaining a 6-inch width (152 mm).

I. Sealant Pocket Extension Legs: Designed for use with the TPO Molded Sealant Pocket and the Pre-Fabricated Sealant Pocket to extend the length in increments of 10 inches (254 mm). Fabricated from 45 mil thick reinforced TPO membrane and TPO coated metal. Can be used full length, cut to size for customized lengths or welded to each other for extra long applications. Color – White. Gray, tan and special colors require custom order fabrication.

J. Pressure-Sensitive Cover Strip: A nominal 6 inch (152 mm) wide by 40 mil thick non-reinforced TPO membrane laminated to nominal 35-mil thick cured synthetic rubber pressure-sensitive adhesive. Used in conjunction with TPO Primer to strip in flat metal flanges (i.e., drip edges or rows of fasteners and plates). Color to match membrane. Special colors not available.

K. TPO Pressure-Sensitive RUSS:

1. 10 inch (254 mm) RUSS: A nominal 10 inch (254 mm) wide, 45 mil thick reinforced TPO membrane with nominal 3 inch (76 mm) wide 35mil thick cured synthetic rubber pressure-sensitive adhesive laminated along both ends. The TPO 10-inch RUSS is used in place of narrow sheets to secure membrane in the perimeter roof area. The use of this product allows field membrane to be utilized over the entire roof area.

L. Heat Weldable Walkway Rolls: Superior tear, puncture and weather resistance and designed to protect membrane in those areas exposed to repetitive foot traffic or other hazards. Walkway material may be heat welded to membrane using an automated heat welder or hand held heat welder. Walkway Rolls are 34 inches (864 mm) wide by 50 feet (15.2 m) long and are nominal 180 mils thick. Color – White.

M. Non-Reinforced Flashing: Non-reinforced TPO flashing is a 60-mil thick non-reinforced TPO based membrane used for detail work where the use of pre-molded or pre-fabricated accessories are not feasible. Color – White, gray and tan. Special colors require lead time and 5,000 square foot minimum.

2.05 CLEANERS, PRIMERS, ADHESIVES AND SEALANTS

A. Bonding Adhesive: A high-strength solvent-based contact adhesive recommended by membrane manufacturer used for bonding membrane to various porous and non-porous substrates:

1. Base: Synthetic Rubber
2. Color: Yellow
3. Solids: 20.0 percent
4. VOC: 670 grams/liter

B. Cut Edge Sealant: A medium solids content, free flowing polymeric material designed for sealing cut edges (exposed fabric) of Sure-Weld reinforced membrane.

C. Water Cut-Off Mastic: A one-component, low viscosity, self wetting, Butyl blend mastic used as a compression sealing agent between membrane and applicable substrates.

D. Low VOC Primer: Manufacturer’s recommended low VOC primer.

E. TPO Primer: Solvent-based product designed to prepare TPO membrane for improved adhesion to TPO surfaces prior to the application of pressure-sensitive products and sealant pockets.

F. Universal Single-Ply Sealant: a 100 percent solids, solvent free, VOC free, one-part polyether sealant that provides a weather tight seal to a variety of building materials. It is used for general caulking such as above termination bars and metal counter flashings and at scupper details. Color: White.

G. Thermoplastic One-Part Sealant: Single component, moisture curing, elastomeric polyether sealant that is compatible with Thermoplastic membrane. Provides a flexible, durable and long lasting seal around hard-to-flash penetrations in Thermoplastic Roofing Systems.

H. Membrane Cleaner: Clear, solvent-based cleaner used to loosen and remove contaminants from the surface of exposed membrane.

2.06 FASTENING COMPONENTS

A. HP-X Fasteners: Heavy-duty #15 threaded fastener with a Phillips head for standard TPO seam fastening (Mechanically Fastened Roofing Systems) and where increased pullout resistance is necessary for steel and wood decks (Fully Adhered Roofing Systems).

B. Pre-Assembled ASAP Fasteners: InsulFast Fastener and pre-assembled 3 inch (76 mm) diameter Plastic Insulation Plate for insulation attachment on adhered and mechanically-fastener roofing systems.

C. HP Term Bar Nail-In: A 1 ¼ inch (32 mm) long expansion anchor with threaded drive pin used for fastening Termination Bar or Seam Fastening Plates to concrete, brick or block walls.

D. Base Sheet Fasteners and Plates:

1. A factory pre-assembled, 1.8 inch (46 mm) long fastener consisting of a precision tube formed from galvanized (G-90) coated steel, a 2.7 inch (69 mm) diameter disk formed from Galvalume (AX-55) coated steel and a locking staple of high tensile steel wire used to secure base sheets to fibrous cement, lightweight concrete and gypsum providing 70 lbs. of pullout resistance is achieved (40 lbs. Min).

2. Base Sheet fasteners and plates by others must be FM approved and the respective manufacturers' published recommendations for proper installation must be followed.

E. Piranha Plates: A 2 3/8 inch (60 mm) diameter metal barbed fastening plate used with Carlisle HP-X, CD-10 or HD 14-10 Fasteners for membrane securement. This plate can be used for insulation securement.

F. Seam Fastening Plates: a 2 inch (52 mm) diameter metal plate used for insulation attachment on Mechanically Fastened Roofing Systems or membrane securement on Adhered Roofing Systems in conjunction with the appropriate Fastener.

G. Insulation Fastening Plates: A nominal 3 inch (76 mm) diameter metal plate used for insulation attachment in conjunction with the appropriate Fastener.

2.07 EDGINGS AND TERMINATIONS

A. Termination Bar: 1 inch (13 mm) wide, 0.98 inch (2.5 mm) thick extruded aluminum bar pre-punched 6 inches (152 mm) on center with sealant ledge to support Lap Sealant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Do not commence work until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment.

D. A vapor retarded / temporary roof may be applied to protect the inside of the structure prior to the roof system installation.

3.03 INSULATION – SYSTEM DESIGN

A. Tapered System:

1. Type: Polyisocyanurate
2. Field Scope: 1/8 to 1/4inch per foot
3. Sump Slope: _____1/4___inch per foot
4. Cricket Slope: ____1/4___inch per foot
5. Attachment Method: Adhered

3.04 INSULATION PLACEMENT

A. Install insulation or membrane underlayment in multiple layers over the substrate with boards butted tightly together with no joints or gaps greater than ¼ inch (6 mm). Stagger joints both horizontally and vertically if multiple layers are provided.

B. Secure insulation to the substrate with the required mechanical fasteners or insulation adhesive in accordance with the manufacturer's current application guidelines.

C. Do not install wet, damaged or warped insulation boards.

D. Stagger joints in one direction unless joins are to be taped. Install insulation boards snug. Gaps between board joints shall not exceed ¼ inch (6 mm). Fill all gaps in excess of ¼ inch (6 mm) with same insulation material.

E. Wood nailers must be at least 3 ½ inches (89 mm) wide or 1 inch (25 mm) wider than adjacent metal flange. Thickness must equal that of insulation but not less than 1 inch (25 mm) thickness).

F. Miter and fill the edges of the insulation boards at ridges, valleys and other changes in plane to prevent open joints or irregular surfaces. Avoid breaking or crushing f the insulation at the corners.

G. Do not install any more insulation than will be completely waterproofed each day.

3.05 INSULATION ATTACHMENT

A. Securely attach insulation to the roof deck for Adhered Roofing Systems. Attachment must have been successfully tested to meet or exceed the calculated uplift pressure required by the International Building Code (ASCE-7) or ANSI / SPRI WD-1.

B. Enhance the perimeter and corner areas in accordance with the International Building Code (ASCE-7) or ANSI / SPRI WD-1.

C. Install insulation layers, maximum 4 feet by 4 feet board size, in a full and uniform mopping of hot asphalt applied at the rate of 25 lb/square. Stagger the joins of additional layers in relation to the insulation joints in the layer9s) below by a minimum o 6 inches.

D. Install insulation layers, maximum 4 feet by 4 feet applied with adhesive, coverage rate as necessary to achieve the specified attachment and uplift rating. Press each board firmly into place after adhesive develops strings when touches, typically 1-1/2 to 2 minutes after adhesive was applied, and roll with a weighted roller. Add temporary weight ad use relief cuts to ensure boards are well adhered. Stagger the joints of additional layers by a minimum of 6 inches.

3.06 MEMBRANE PLACEMENT AND ATTACHMENT (Sure-Weld Fully Adhered)

A. Position membrane over the acceptable substrate. Fold membrane sheet back lengthwise so half the underside of the membrane is exposed.

B. Apply Bonding Adhesive in accordance with the manufacturer's published instructions, to the exposed underside of the membrane and the corresponding substrate area. Do not apply Bonding Adhesive along the splice edge of the membrane to be hot air welded over the adjoining sheet. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

1. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded section of the membrane sheet immediately after rolling the membrane into the adhesive with a soft bristle push broom to achieve maximum contact.

2. Fold back the unbonded half of the sheet lengthwise and repeat the bonding procedures.

C. Position adjoining sheets to allow a minimum overlap of 2 inches.

D. Hot-air weld the membrane sheets using the Automatic Hot Air Welding Machine or Hot Air Hand Welder in accordance with the manufacturer's hot air welding procedures. Carlisle recommends a test weld sample be made from a piece of scrap TPO to eliminate the need to remove a section from a completed seam. At all splice intersections, roll the seam with a silicone roller to ensure a continuous hot air welded seam.

E. Continue to install adjoining membrane sheets in the same manner, overlapping edges a minimum of 2 inches and compete the bonding procedures as stated previously.

3.07 SEAM WELDING

A. Hot-air weld membrane using an Automatic Hot Air Welding Machine or Hot Air Hand Welder in accordance with the manufacturer's current guidelines. At all splice intersections, roll the seam with a silicone roller to ensure a continuous hot air welded seam.

B. Overlay all splice intersections with Sure-Weld T-Joint Cover.

C. Probe all seams once the hot air welds have thoroughly cooled (approximately 30 minutes).

D. Repair all seam deficiencies the same day they are discovered.

E. Apply Cut Edge Sealant on all cut edges of reinforced membrane (where the scrim reinforcement is exposed) after seam probing is complete. Cut Edge Sealant is not required on vertical splices.

3.08 FLASHING

A. Flashing of parapets, curbs, expansion joints and other parts of the roof must be performed using reinforced membrane or prefabricated accessories. Non-reinforced membrane may be used for flashing pipe penetrations, Sealant Pockets, and scuppers, as well as inside and outside corners, when the use of pre-molded or prefabricated accessories is not feasible.

B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging / copying and roof drain applications.

3.09 WALKWAYS

A. Install walkways at all traffic concentration points (such as roof hatches, access doors, rooftop ladders, etc.) and all locations as identified on the Contract Drawings.

B. Hot-air weld walkway pads to the membrane in accordance with the manufacturer's current application guidelines.

C. Loose lay concrete pavers over an approved protection sheet in accordance with the manufacturer's current application guidelines.

3.10 DAILY SEALS

A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.

B. Complete an acceptable membrane seal in accordance with the manufacturer's requirements.

3.11 CLEAN-UP

A. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.

B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

3.12 PROTECTION

A. Protect installed products until completion of project.

B. Tough-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 54 23
THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING

SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 GENERAL

1.01 SCOPE

A. Provide all materials, labor, services, and incidentals necessary for the completion of this Section of the Work.

B. Include all metal fascia and related work.

PART 2 PRODUCTS

2.01 METAL FLASHINGS

A. Flashing for roof penetrations, base and counter flashing systems, valley flashing and flashing at wood decks shall be furnished and installed in locations shown on Architectural Drawings. All required/critical areas of SMACNA Manual. (Note: Flashing to be set in asphaltic waterproof mastic/roofing cement.)

B. Flashing to be minimum 24 gage galvanized steel (painted) or painted terne metal, .015 in.

C. All joints to be double secured and heavily soldered with noncorrosive solder.

D. Flashing to be fastened with nails of material compatible with flashing.

E. Installation, accessories, fasteners shall be in accordance with SMACNA Manual requirements (ref. pages 74 – 85.)

F. All flashing not shown but required to achieve a water-tight condition shall be furnished.

PART 3 EXECUTION

3.01 GENERAL

A. Shape and install sheet metal items as indicated. Furnish items to be installed by other trades to the proper trade for installation.

B. Except where otherwise detailed, comply with applicable recommendations of “Architectural Sheet Metal Manual” by SMACNA.

C. Fabricate and install all work with lines and corners true and accurate Form exposed faces flat and free of buckles, and waves.

END OF SECTION 07 60 00
FLASHING AND SHEET METAL

SECTION 07 90 00

BUILDING SEALANTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

The Conditions of the Contract and the General Conditions are hereby made part of this Section.

1.02 WORK INCLUDED

A. Furnish all labor and materials to install caulking and sealants in general building construction and control joints, including following principal items:

1. Seal all joints between wood.
2.
3. Seal all wood-to-wood joints.

1.03 RELATED WORK

A. General Building sealant is directly related to and shall be compatible with:

1. Section 03 30 00 Cast-in-Place Concrete

2. Section 03 34 00 Pre-Cast Concrete

3. Section 07 10 00 Water Proof Coatings

4. Section 09 90 00 Painting

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to site in original sealed containers with seals unbroken, and labels intact bearing manufacturer's name and brand name of product.

B. Store materials under cover, protected from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.05 SUBMITTALS

A. Submit manufacturer’s spec data sheets and color charts for all proposed sealant materials.

1.06 WARRANTY

A. Furnish written guarantee to Owner, warranting that all sealant or caulking shall remain in serviceable, watertight, elastic, adhesive condition for period of 2 years from date of final payment, abuse beyond control of Contractor being excepted.

B. Without additional cost to Owner, repair any damage or imperfections which may develop during guarantee period, and any damage to other Work caused by repair of such imperfections.

PART 2 PRODUCTS

2.01 MATERIALS

A. Type 1: Interior working joints – Two-part urethane sealant.

1. Tremco, Dymeric, or Dymeric Three Part
2. Harry S. Peterson Co., Inc., Iso-Flex 907
3. Pecora Corp., Dynatrol II
4. Sonneborn, Sonolastic NP II
5. Mameco International, Vulkem 227

B. Type 2: Interior Non-working joints – One-part acrylic sealant.

1. Tremco, Mono
2. Pecora Corp., 60 Plus Unicrylic
3. "Dymeric", Tremco, Cleveland, Ohio;
4. "Iso-Flex 825", Lymtal International, Inc., Lake Orion, MI;
5. Or approved equivalent.

C. Type 3: Interior “wet area” joints – Silicone mildew-resistant sealant.

1. General Electric Co., SCS1702 Sanitary Sealant
2. Dow Corning Corp., No 786 Mildew Resistant

D. Type 4: Exterior joints – Two or three-component, Type II, non-sag, urethane sealant, conforming to ASTM C920.

E. Type 5: Fire Rated Acoustical Sealants

1. Rectorseal Metacaulk 1200.
2. Pecora Corp AC-20 FTR.
3. Sheetrock brand acoustical sealant.

F. Packing and backer rod: Expanded polyethylene sheets or rope.

G. Compounds used for sealants shall not stain masonry or concrete. Aluminum pigmented compounds are not acceptable.

H. Color of sealants where exposed shall match adjacent surfaces.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect surfaces to receive sealant and report immediately in writing to Architect any deficiencies in surface which render it unsuitable for proper execution of Work. Proceed with Work only after deficiencies have been acceptably remedied

3.02 PREPARATION

A. Where masonry is specified to be cleaned, install sealant after cleaning.

B. All surfaces that are to receive sealant shall be dry and thoroughly cleaned of all loose particles, dirt, dust, oil, grease, or other foreign matter. Where openings are more than 1/2" in depth, fill joints with backer rod or packing to within 1/2" of surface before sealing and after priming of surfaces.

C. Check preparation of substrate for adhesion of sealant.

D. Prime and seal joints according to manufacturer's directions and protect as required until sealant is fully cured.

E. Cease installation of sealants under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation.

3.03 INSTALLATION

A. Use pressure gun to fill joints completely with sealant of proper consistency.

B. Completely fill joint without sagging or smearing onto adjacent surfaces.

END OF SECTION 07 90 00
BUILDING SEALANTS

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated steel doors and frames.

B. Steel frames for wood doors.

C. Fire-rated steel doors and frames.

D. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED SECTIONS

A. Door Hardware.

B. Painting and Coating: Field painting.

C. Fiberglass Interior Doors.

1.03 REFERENCES

A. ANSI/ICC A117 1 – American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.

B. ANSI A250.3 – Test Procedure and Acceptance Criteria for Factory-Applied Finish Painted Steel Surfaces for Steel Doors and Frames; 1999.

C. ANSI A250.8 – SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.

D. ANSI A250.10 – Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2004).

E. ASTM A 653/A 653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2005a.

F. ASTM C 236 – Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box; 1989 (Reapproved 1993).

G. ASTM C 1363 – Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus; 2005.

H. ASTM E 90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2004.

I. ASTM E 413 – Classification for Rating Sound Insulation; 2004.

J. ASTM E 1408 – Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems; 1991 (Reapproved 2000).

K. DHI A115 Series – Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute; 2000 (ANSI/DHI A115 Series).

L. NAAMM HMMA 840 – Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 1999.

M. NAAMM HMMA 860 – Guide Specifications for Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 1992.

N. NAAMM HMMA 861 – Guide Specifications for Commercial Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2000.

O. NAAMM HMMA 862 – Guide Specifications for Commercial Security Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2003.

P. NFPA 80 – Standard for Fire Doors and Fire Windows; National Fire Protection Association; 2007.

Q. NFPA 252 – Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2003.

R. UL (BMD) – Building Materials Directory; Underwriters Laboratories Inc., current edition.

S. UL 10B – Standard for Fire Tests of Door Assemblies; 1997.

T. UL 10C – Standard for Positive Pressure Fire Tests of Door Assemblies, 1998.

1.04 SUBMITTALS

A. See Section 01 30 00 – Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

D. Certificate of recycled content.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

1.06 DELIVERY, STORAGE, AND PROECTION

A. Store in accordance with NAAMM HMMA 840.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Doors and Frames:

1. Curnes
2. Ceco Door Products
3. Windsor Republic Doors
4. Steelcraft
5. Mesker

2.02 DOORS AND FRAMES

A. Requirements for All Doors and Frames:

1. Accessibility: Comply with ANSI/ICC A117 1.

2. Door Top Closures: Flush with top of faces and edges.

3. Door Edge Profile: Beveled on both edges.

4. Door Texture: Smooth faces.

5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Square pattern for wire glass.

6. Hardware Preparation: In accordance with DHI A115 Series, with reinforcement welded in place, in addition to other requirements specified in door grade standard.

7. Finish: Factory primed, for field finishing.

8. Exterior Doors: 18 gauge galvanized door and frame with stainless steel hinges.

9. Bituminous coated frames to be grouted.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 STEEL DOORS

A. Exterior Doors, Non-Fire-Rated:

1. Grade: ANSI A250.8 Level 3, full flush, 18 gauge galvanized finish.

2. Core.

3. Thickness: 1-3/4 inches.

4. Texture: Smooth faces.

5. Finish: Factory primed, for field finishing.

B. Interior Doors, Fire-Rated:

1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush.

2. Fire Rating: As indicated on drawings, tested in accordance with UL 10C ("positive pressure").

   a. Provide units listed and labeled by UL.
   b. Attach fire rating label to each fire rated unit.

2.04 STEEL FRAMES

A. General:

1. Comply with the requirements of grade specified for corresponding door.

   a. ANSI A250.8 Level 2 Doors: 18 gage frames.
   b. ANSI A250.8 Level 3 Doors: 16 gage frames.
   c. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 2

2. Finish: Factory primed, for field finishing.

3. Provide mortar guard boxes for hardware cut-outs in frames, or to be grouted.

B. Interior Door Frames in fire-rated walls: Fully welded.

1. Fire Rating: Same as door, labeled.

2. Finish: Factory primed, for field finishing.

C. Interior Door Frames in gypsum board walls: Fire rated and non-fire rated: Knock-down type.

1. Finish: Factory primed, for field finishing.

2. Fire Rating: Same as door, labeled.

2.05 ACCESSORY MATERIALS

A. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.

B. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door.

C. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.06 FINISH MATERIALS

A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.

B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

3.02 PREPARATION

A. Coat inside of frames to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.

B. In addition, install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in precast concrete construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Coordinate installation of hardware.

F. Coordinate installation of glazing.

G. Coordinate installation of electrical connections to electrical hardware items.

H. Touch up damaged factory finishes.

3.04 ERECTION TOLERANCES

A. Clearances Between Door and Frame: As specified in ANSI A250.8.

B. Maximum Diagonal Distortion: 1/16 in. measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Test sound control doors for force to close, latch, and unlatch in accordance with ASTM E 1408; adjust as required to comply.

END OF SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

SECTION 08 16 00

COMPOSITE and FIBERGLASS ENTRY DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood doors and panels; fire rated and non-rated.

1.02 SUBMITTALS

A. Shop Drawings: Indicate door elevations.

B. Samples: Submit two of door veneer, illustrating wood grain, color, and finish.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with the following:
1. NWDA I.S.I.
2. Fire Door and Panel Construction: Conform to UL 10B.

PART 2 PRODUCTS

2.01 UNIT INTERIOR SWING DOORS

A. Manufacturers: Masonite Corporation, Plaspro, Jeld-Wen, or Equivalent.

B. Doors shall be 1-3/8 inch thick x 8 foot-0 inches high, solid, pre-finished. Field verify sizes and locations. Color: Primed.

PART 3 EXECUTION

3.01 LOCATIONS

A. Unit Interior Swing Doors
1. Bedroom and Bathroom
2. Doors to be installed with new lever hardware

B. Unit Entry Doors:
1. 8’-0 inches high, Solid Core, Flush, with 20 minute rating.
2. 1 ¾” thickness door shall be factory prepped for hardware.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer’s instruction requirements.

B. Coordinate installation of doors with installation of hardware specified in Section 08 71 00.

C. Adjust door for smooth and balanced door movement.

3.03 INSTALLATION TOLERANCES

A. Conform to ANSI/NWWDA requirements for fit and clearance tolerances and maximum diagonal distortion.

END OF SECTION 08 16 00
COMPOSITE and FIBERGLASS ENTRY DOORS

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Access door and frame units, fire-rated and non-fire rated, in wall, and ceiling locations as required for all construction trades.

1.02 RELATED SECTIONS

A. Painting and Coating: Field paint finish.

1.03 REFERENCES

A. UL (FRD) – Fire Resistance Directory; Underwriters Laboratories, Inc., current edition.

1.04 SUBMITTALS

A. See Division 01 Specification Section – Administrative Requirements, for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Manufacturer's Installation Instructions: Indicate installation requirements.

D. Project Record Documents: Record actual locations of all access units.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire-rated access doors.

1. Provide access doors of fire rating equivalent to the fire rated assembly in which they are to be installed.

B. Provide products listed and labeled by UL as suitable for the purpose specified and indicated.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated doors.

1.06 PROJECT CONDITIONS

A. Coordinate the work with other trades requiring access doors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Access Doors:

1. Karp Associates, Inc.

2. Milcor, Inc.

2.02 ACCESS DOOR UNITS – WALLS

A. Door and Frame Units: Formed steel.

1. Frames and flanges: 0.058 inch steel.

2. Door panels: 0.070 inch single thickness steel sheet.

3. Size: As indicated.

4. Hardware:

a. Hinge: Concealed constant force closure spring type.
b. Lock: Screw driver slot for quarter turn cam lock.

5. Prime coat with alkyd primer.

2.02 FABRICATION

A. Weld, fill, and grind joints to ensure flush and square unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings for door and frame are correctly sized and located.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings. Secure rigidly in place.

C. Position units to provide convenient access to the concealed work requiring access.

END OF SECTION 08 31 00
ACCESS DOORS AND PANELSS

SECTION 08 44 13

ALUMINUM-FRAMED ENTRANCES and CURTAINWALL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Aluminum entrance doors and frames.
2. Aluminum framed glazed curtainwall.
3. Glass infill panels.
4. Door hardware.

1.02 REFERENCES

A. American Architectural Manufacturers Association (AAMA):

1. 611 – Voluntary Specification for Anodized Architectural Aluminum.
2. 1503 – Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

B. American National Standards Institute/ Builders Hardware Manufacturers Association (ANSI/BHMA) A156.3 – Exit Devices.

C. American Society of Civil Engineers (ASCE) 7 = Minimum Design Loads for Buildings and Other Structures.

D. ASTM International (ASTM):

1. B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. E283 – Standard Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors.
4. E330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors under the Influence of Wind Loads.
5. E331 – Standard Test Method for Water Penetration of Exterior Windows, Doors, and Curtain Walls by Uniform Static Air Pressure Differential.
6. E547 – Standard Test Method for Water Penetration of Exterior Windows, Doors, and Curtain Walls by Cyclical Static Air Pressure Differential.

7. E783 – Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

8. E1105 – Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference.

E. Underwriters Laboratories (UL) 305 – Safety Panic Hardware.

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Design (exterior) systems to withstand:

1. Design wind pressure in accordance with ASCE 7, Building Code, with maximum allowable deflection of L/175, tested in accordance with ASTM E330.

2. Movement caused by an ambient temperature range of 120 degrees F and a surface temperature range of 160 degrees F.

B. Performance Requirements:

1. Air infiltration, tested to ASTM E283.
    a. Entrances:
        i. Single door: Maximum 0.5 CFM per minute per linear foot of perimeter crack, at static pressure differential of 6.24 PSF.
        ii. Pairs of doors: Maximum 1.0 CFM per minute per linear foot of perimeter crack, at static pressure differential of 1.567 PSF.

    b. Curtainwall: 0.06 CFM per square foot of fixed area at static pressure differential of 6.24 PSF.

2. Water infiltration: No uncontrolled water leakage, tested to ASTM E331, E547, at minimum test pressure of 6.24 PSF for inswing doors and 8.0, 15.0 PSF for outswing doors and storefront.

3. Uniform structural loading: No glass breakage or permanent damage to fasteners or system components, tested to ASTM E330 at 1.5 times design pressure.

4. Thermal transmittance due to conduction (Uc): Maximum 0.60, tested to AAMA 1503 on two 6’-0” x 6’-0” units with 1 inch clear insulating glass.

5. Condensation resistance factor (CRF): Minimum 65, tested to AAMA 1503.

1.04 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, trim, sealers, hardware, and accessories.

B. Quality Control Submittals:

1. Test Reports: Certified results of previous tests by a recognized independent laboratory substantiating compliance with specified design and performance criteria, current within past 5 years.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years documented experience in work of this Section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Kawneer Co., Inc. (www.kawneer.com). 1600 Wall: Series 2

2. Tubelite, Inc. (www.tubeliteinc.com). 400 Wall

3. Vistawall Architectural Products. (www.vistawall.com). (Oldcastle Building Envelope). CW-250

2.02 MATERIALS

A. Aluminum:

1. Extrusions: ASTM B221, 6063-T5 alloy and temper.

2. Sheet: ASTM B209, alloy and temper best suited to application.

3. Recycled content: Minimum 75 percent, with minimum 40 percent classified as post consumer.

2.03 COMPONENTS

A. Entrances Doors: Wide stile configuration with nominal 5 inch vertical stiles and top rail and 10” inch bottom rail.

B. Curtainwall: Two (2) sided butt glazing system designed to receive 1” inch glass by means of elastomeric gaskets; 2 1/2” inch face width by 7 ¼” inch depth, thermally broken.

C. Door Hardware:

1. Continuous gear hinges: Manufacturer’s standard, full mortise, five knuckle, ball bearing type with non-rising pins.

2. Closers:
   a. Overhead adjustable parallel arm closing and latching speed and backcheck.
   b. Adjustable opening force and delayed closing in accordance with applicable accessibility code.

3. Exit Devices:

a. UL 305 and ANSI/BHMA A 156.3, Grade 1, design.
b. Outside trim: To be selected from manufacturer's full range of selections.

4. Push and pull: To be selected from manufacturer's full range of selections.

5. Thresholds: 4 inches wide x ½ inch high, aluminum, A.D.A. rated.

2.04 ACCESSORIES

A. Fasteners:

1. Series 300 stainless steel for wet locations and exposed fasteners.

2. Stainless or fluoropolymer coated steel for other locations.

B. Building Sealants: Specified in Section 07 90 00.

C. Glass and Glazing Accessories: Manufacturer's recommended accessories for application on this project.

D. Weatherstripping: Replaceable, resilient bulb type.

2.05 FABRICATION

A. Fabricate with minimal clearances and shim spaces around perimeter.

B. Accurately fit and secure joints and intersections. Make joints flush, hairline, and weathertight.

C. Fabricate in largest practical units.

D. Conceal fasteners and attachments from view.

E. Fabricate aluminum components with integral low conductance thermal barrier located between exterior and interior exposed components that eliminates metal-to-metal contact.

F. Doors:

1. Mechanically fastened and welded corner construction.

2. Fabricate stiles and rails of minimum 0.125 inch thick extrusions and glass stops from minimum 0.050 inch thick extrusions.

3. Provide weatherstripping at door head, jambs, meeting stiles, and sills.

4. Prepare with internal reinforcements for door hardware.

2.06 FINISHES

A. Aluminum: No powder coat painted.

1. Organic finish applied over a 5-Stage aluminum pre-treatment. Finish shall be based on a “Kynar 500” resin and applied as a two coat, two bake system with a 1.2 mil minimum thickness and shall conform to AAMA 2605. Color to be chosen by Architect.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions and approved Shop Drawings.

B. Install components plumb and level, in proper plane, free from warp and twist.

C. Anchor to supporting construction.

D. Set thresholds and sill members exposed to weather in full bed mastic and secure.

E. Install hardware using templates provided b manufacturer.

F. Install glass and accessories in accordance with Section 08 80 00.

G. Installation Tolerances:

1. Maximum variation from plumb or level: 1/8 inch in 3 feet.

2. Maximum misalignment of members abutting end to end: 1/32 inch.

3. Sealant space between framing members and adjacent construction: ½ inch plus or minus 1/8 inch.

3.02 ADJUSTING

A. Adjust hardware for smooth operation.

B. Adjust doors to operate with maximum opening forces in accordance with applicable accessibility code, as follows:

1. Interior doors: 5.0 pounds.

2. Exterior doors: 8.5 pounds.

C. Touch up minor scratches and abrasions to match original finish.

D. Adjust weatherstripping to contact appropriate surfaces and form weather seal.

END OF SECTION 08 44 13
ALUMINUM-FRAMED ENTRANCES and CURTAINWALL

SECTION 08 71 00

FINISH HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood doors.

B. Thresholds, weather-stripping, seals, door gaskets kickplates, viewers, etc.

1.02 SUBMITTALS

A. Shop Drawings: Indicate locations and mounting heights of each type of hardware, electrical characteristics and connection requirements.

B. Operating and Maintenance Instructions: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.03 COORDINATION

A. Coordinate work of this section with other directly affected sections requiring any integral reinforcement for door hardware.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually. Label and identify package with door opening code to match schedule.

B. Deliver keys to Owner direct from hardware supplier.

1.05 MAINTENANCE

A. Provide special wrenches and tools applicable to each different or special hardware component.

B. Furnish the Owner with two (2) complete sets of installation instructions, service manuals, maintenance helps and special wrenches or keys required to keep hardware in adjustment. This material shall be in two separate packets – one for Owner's files and one for Owner's maintenance staff.

PART 2 PRODUCTS

2.01 MATERIALS

A. All hardware to meet MPS 508-7.1 and 402-3.4.

B. Hardware all conform to F.S.F.F.h. – 00106 and with the applicable series as follows:
1. Living unit entry doors – Sargent Deadbolt Mortise Lock MA531 DG 626 with Full Plate Trim.

C. All Unit Entry lock sets and latches to have lever type handles approved for use by the physically handicapped. *Note: All latch/lock sets to be lever type.

2.02 SUPPLIERS

A. Hardware by the following manufacturers will be considered approved, provided that design, function, finish and gage of metal are consistent with the item listed herein.

1. Butts: Stanley, Hager, Lawrence, or McKinney.

2. Locks and Latches: Typical – Sargent.

3. Stops: Ives, Glynn Johnson, Baldwin.

4. Thresholds and Weatherstripping: National Guard

5. Miscellaneous Hardware: Companies previously listed.

6. Panic Devices and Closers: Arrow, Corbin Russwin, Sargent, LCN or Yale.

B. Hardware of other manufacturer's equal in design, quality, and function may be substituted only under conditions stipulated.

2.03 KEYING

A. Unit entry doors – 2 keys/cylinder for each unit entry door.

B. Master Key – 1/building

C. Mechanical Room Doors – 1 key/cylinder – tied to building master.

D. Outdoor Maintenance – 2 keys – tied to building master.

E. Furnish a complete schedule of key markings and master key system to Owner.

2.04 FINISHES

A. All hardware shall be Polished Chrome.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Install Kick Plate where required.

B. Verify that doors and frames are ready to receive work.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions. Note: New hardware at existing locations to fit existing cutouts.

B. Use templates provided by hardware item manufacturer.

C. Coordinate electric latches with security contractor and electrical contractor.

D. Hardware installer responsible for the installation of all electrified components, as specified in hardware sets, into doors, frames, and walls.

E. Electrical contractor responsible for installation of all conduit, and pulling of all low voltage wire related to the completion of electrified hardware systems, the installation of power supplies, connection of AC power to the power supplies and all 120 VAC operated hardware (AC power to Automatic Operators).

F. Hardware supplier to provide for installation of automatic operators. This includes only the actual installation and connection of device and related components (actuators, relays, sequencers) and is not to include connection of 120 VAC power to device. Coordinate any access control operation with access control/security contractor.

3.03 ADJUSTING

A. Adjust work under provisions of Division 01 – Specification Sections.

B. Adjust hardware for smooth operation.

3.04 PROTECTION OF FINISHES WORK

A. Protect finished Work under provisions of Division 01 – Specification Sections.

B. Do not permit adjacent work to damage hardware or finish.

3.05 SCHEDULE: At end of Section.

A. It is the responsibility of the supplier to thoroughly detail the entire project to assure that the items specified or required will properly function for the indicated locations. Check for template hardware, special brackets, special fastenings, or any other details that may affect the function of the hardware.

B. Prepare a complete schedule including all items proposed for each opening and other miscellaneous items and submit five copies to the Architect for approval.

C. Indicate on schedule the name of manufacturer of each item.

D. Coordinate hardware with new door and frame suppliers and entry doors.

E. Unit entry doors – Sargent integrated single throw mortise latchset with deadbolt and viewer (peep hole). 54 inches mounting height typical. Provide a second view for barrier free unit entry doors – 45 inches mounting height.

F. Interior Unit Doors – Provide Privacy lockset with push button (NOT Thumb Turn) at all bathrooms. Provide passage sets at all other interior swinging doors.

3.06 LOCATION

A. See Drawings for hardware locations.

DOOR HARDWARE SCHEDULE

Item	Location	Description	Source
A	Front/Rear Entrance	2 pair Butts	By Door Manufacturer
		1 Closer	By Door Manufacturer
		1 Electric Strike / Card Reader	By Security Contractor
		1 Exit Device	By Door Manufacturer
		1 Pull	By Door Manufacturer
		1 ADA Threshold	By Door Manufacturer
		Weather stripping	By Door Manufacturer
		Sweep	By Door Manufacturer
B	Vestibule	2 pair Butts	By Door Manufacturer
		1 Closer	By Door Manufacturer
		1 Electric Strike	By Security Contractor
		1 Exit Device	By Door Manufacturer
		1 Pull	By Door Manufacturer
C	Exit Door	2 pair Butts	By Door Manufacturer
		1 Closer	By Door Manufacturer
		1 Exit Device	By Door Manufacturer
D	Patio	2 pair Butts	By Door Manufacturer
		1 Closer	By Door Manufacturer
		1 Exit Device w/ Ext. Lever Trim	By Door Manufacturer
E	Retail	1 ½ Pair Butts	By Hager
		1 Passage Set	Sargent
		1 Deadbolt lock keyed both sides	Sargent
F	Storefront	2 pair Butts	By Door Manufacturer
		1 Closer	By Door Manufacturer
		1 set Push/Pull	By Door Manufacturer
		1 Deadbolt Lock w/ Exit Paddle	By Door Manufacturer
		Weather stripping	By Door Manufacturer
		ADA Threshold	By Door Manufacturer
G	Department Entry	2 pair Butts	By Door Manufacturer
		1 Closer	By Door Manufacturer
		1 set Push/Pull	By Door Manufacturer
		1 Deadbolt lock with thumbturn	By Door Manufacturer
H	Office	1 ½ Pair Butts	By Hager
		1 Office lockset	Sargent
J	Unisex Restroom	1 ½ Pair Butts	By Hager
		1 Privacy set with thumbturn	Sargent

Item	**Location**	**Description**	**Source**
K	Restroom	1 ½ Pair Butts	By Hager
		1 Closer	LCN
		1 set Push/Pull	
		1 Kickplate pushside	
		1 Deadbolt lock w/thumbturn push side	
L	Janitor	1 ½ Pair Butts	By Hager
		1 Closer	LCN
		1 Storeroom lockset	Sargent
		2 Kickplates (Room 005 only)	
M	Kitchen	1 Multi-swing Kitchen Door	By Door Manufacturer
N	Storage Closet	3 Pair Butts	By Hager
		1 Head Bolt	
		1 Dummy Trim	Sargent
		1 Storeroom Lockset	Sargent
P	Community Room	3 Pair BB Butts	By Hager
		2 Closers	LCN
		1 Coordinator	
		2 Concealed Rod Exit Devices w/ Ext. Lever Trim	
Q	Training / Conference	1 ½ Pair Butts	By Hager
		1 Interconnected Entry Set	Sargent
		1 Closer	LCN
R	Roof Access /	1 ½ Pair Butts	By Hager
	Trash Garage	1 Passage set	Sargent
		1 Deadbolt	
		Weather stripping	
		Door sweep	
S	Horizontal Exit	1 ½ Pair Butts	By Hager
		1 Closer w/ integrated Hold-open Connect to Bldg Smoke Detection System	
		1 Door Bottom	
		Smoke Seals	
		1 Exit Device w/ electric lock & Ext Lever Trim	
		1 Electric Power Transfer	
		1 Power Supply	
		1 Proximity Card Reader	
		1 Kickplate	

T	Egress Balcony	1 ½ Pair Butts	By Hager
		1 Closer	
		1 Exit Device	
		1 Kickplate	
		1 Pull	
Item	**Location**	**Description**	**Source**
U	Trash Chute	1 ½ Pair Butts	By Hager
		1 Closer	LCN
		1 Passage Latchset	Sargent
		2 Kickplates	
V	Sliding Door	1 Sliding Door Lock Thumbturn	
		2 – 4” wire pulls	
W	Herkimer Court	1 ½ Pair BB Butts	By Hager
		1 Auto Operator w/ 2 actuator buttons	
		2 Kickplates	
		1 Exit Device w/ Lever Trim	
		1 ADA Threshold	
		Weather stripping	
X	Ramp Exit	1 ½ pair BB Butts	By Hager
		1 Closer	LCN
		1 Exit Device w/ Lever Trim	
		2 Kickplates	
		Weather stripping	
		1 Flip up door stop	
		1 ADA Threshold	
Y	Vestibule	1 ½ Pair BB Butts	By Hager
		1 Closer	LCN
		1 Exit Device w/ Lever Trim	
		2 Kickplates	
Z	Trash Garage	1 ½ pair BB Butts	By Hager
		1 Closer	LCN
		1 Classroom lock	Sargent
		1 Deadbolt	
		2 Kickplates	
		Weather stripping	

END OF SECTION 08 71 00
FINISH HARDWARE

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Glass for other sections referencing this Section.

1.02 REFERENCES

A. American Architectural Manufacturers Association (AAMA) 800 – Voluntary Specifications and Test Methods for Sealants.

B. American National Standards Institute (ANSI) Z97.1 – Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

C. American Society of Civil Engineers (ASCE) 7 – Minimum Design Loads for Buildings and Other Structures.

D. ASTM International (ASTM):

1. C509 – Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.

2. C864 – Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

3. C920 – Standard Specification for Elastomeric Joint Sealants.

4. C1036 – Standard Specification for Flat Glass.

5. C1115 – Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.

6. E119 – Standard Test Method for Fire Tests of Building Construction and Materials.

7. E152 – Standard Test Method for Fire Test of Door Assemblies.

8. E330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

9. E774 – Standard Specification for Sealed Insulating Glass Units.

10. E1300 – Standard Practice for Determining Load Resistance of Glass in Buildings.

11. E2190 – Standard Specification for Insulating Glass Unit Performance and Evaluation.

12. F1233 – Standard Specification for Security Glazing Materials and Systems.

E. Glass Association of North America (GANA):

1. Engineering Standards Manual.

2. Glazing Manual.

1.03 SUBMITTALS

A. Submittals for Review:

1. Product Data: Descriptive data and performance attributes for insulated glass.

B. Quality Control Submittals:

1. Test Report: Preconstruction adhesion and compatibility test report from glazing sealant manufacturer, based on acceptable data from previous testing of current formulations with similar products.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years documented experience in work of this Section.

B. Regulatory Requirements: Provide tempered safety glass for locations subject to human impact as required by Building Code.

C. Perform Work in accordance with GANA Glazing Manual SIGMA TM-3000 and IGMA TB-3001.

1.05 PROJECT CONDITIONS

A. Perform glazing when ambient temperature is above 40 degrees F.

B. Perform glazing on dry surfaces.

1.06 WARRANTIES

A. Insulating Glass Units: Provide manufacturer’s 10 year warranty against material obstruction of vision through unit due to:

1. Intrusion of dust or moisture.

2. Internal condensation.

3. Film formation on internal glass surfaces caused by failure of hermetic seal except failure caused in whole or in part by breakage or fracturing of any portion of glass surface.

B. Glass Coatings: Provide manufacturer’s 10 year warranty against peeling, cracking, or deterioration of coating under normal conditions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers – Glass: Spec is based on PPG.

1. Guardian Industries Corp. (www.guardian.com)

2. Pilkington Architectural. (www.pilkington.com)

3. PPG Industries, Inc. (www.ppgglazing.com)

4. Viracon, Inc. (www.viracon.com)

2.02 MATERIALS – GLASS

A. Clear Tempered glass: ASTM C1048, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select, Kind FT fully tempered.

B. Low-E Coated Glass: Apply low-emissivity coating to scheduled glass surface. Use only low e coating with a bronze or grey tone. Do not use low e coating with green tone.

C. Tinted Glass: ASTM C1376.

2.03 ACCESSORIES

A. Setting Blocks: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone, 80 to 90 Shore A durometer hardness.

B. Spacers: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 50 to 60 Shore A durometer hardness.

C. Glazing Gaskets:

1. Dense compression gaskets: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone or thermoplastic polyolefin rubber, molded or extruded shape to fit glazing channel retaining slot; black color.

2. Soft compression gaskets: ASTM C509, Type II, black, molded or extruded, neoprene, EPDM, silicone or thermoplastic polyolefin rubber, of profile and hardness required to maintain watertight seal; black color.

D. Weatherseal Sealant:

1. Type: Single component, low modulus, neutral moisture curing silicone sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT, M, G and A.

2. Movement capability: Fifty (50%) percent in extension and compression.

E. Sealant Backing: ASTM C1330, Type O, size and density to control glazing sealant depth and produce optimum glazing sealant performance.

F. Primer: As recommended by glazing sealant manufacturer.

2.04 FABRICATION

A. Tempered Glass:

1. Comply with ASTM C1048.

2. Process in horizontal position so that inherent roller distortion will run parallel to building floor lines after installation.

B. Sealed Insulating Glass:

1. Comply with ASTM E774 and ASTM E2190.

2. Fabricate spacer bar frame of tubular aluminum filled with desiccant. Color: Clear Mill Finish Aluminum.

3. Bond spacer bar frame to glass panes with twin primary seals.

4. Fill space outside frame to glass edge with elastomeric sealant.

C. Fabrication Tolerances: ASTM C1036 and ASTM C1048.

D. Glass Identification:

1. Apply manufacturer's label indicating type and thickness to each light of glass. Show position of exterior face when installed, where applicable.

2. Etch manufacturer's label on each light of tempered glass.

E. Source Quality Control:

1. Preconstruction adhesion and compatibility testing:

a. Perform adhesion test including ultraviolet exposure through glass on production samples of metals and glass in accordance with ASTM C794.

b. Test glass units, glazing materials, and glass framing members with specified finish for sealant compatibility, priming, and preparation requirements for optimum adhesion and performance.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean glazing rabbets; remove loose and foreign matter.

B. Remove protective coatings on metal surfaces.

C. Clean glass just prior to installation.

3.02 INSTALLATION – GENERAL

A. Install glass in accordance with glass manufacturer's instructions.

B. Maintain manufacturer's recommended edge and face clearances between glass and frame members.

3.03 INSTALLATION – GASKET GLAZING METHOD

A. Fabricate gaskets to fit openings; allow for stretching of gaskets during installation.

B. Set soft compression gasket against fixed stop or frame with bonded miter cut joints at corners.

C. Set glass centered in openings on setting blocks.

D. Install removable stops and insert dense compression gaskets at corners, working toward centers of glass, compressing glass against soft compression gaskets to produce weathertight seal.

E. Seal joints in gaskets.

F. Allow gaskets to protrude past face of glazing stops.

3.04 PROTECTION

A. After installation, mark glass with an 'X' using removable plastic tape.

END OF SECTION 08 80 00
GLAZING

SECTION 08 91 00

LOUVERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fixed louvers and frames.
2. Bird screens.
3. Blank off panels.

B. Related Sections:

1. Division 01: Administrative, procedural, and temporary work requirements.

1.02 REFERENCES

A. Air Movement and Control Association International, Inc. (AMCA) Standard 500 – Test Methods for Louvers, Dampers, and Shutters.

B. American Architectural Manufacturers Association (AAMA):

1. 611 – Voluntary Specification for Anodized Architectural Aluminum.

2. 620 – Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Aluminum Substrates.

3. 621 – Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.

4. 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Architectural Extrusions and Panels.

C. American Society of Civil Engineers (ASCE) 7 – Minimum Design Loads for Buildings and Other Structures.

D. ASTM International (ASTM):

1. A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

2. B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

3. E330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors under the Influence of Wind Loads.

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Design louvers to withstand:

1. Design wind pressure in accordance with ASCE 7, with maximum allowable deflection tested in accordance with ASTM E330.

2. Movement caused by an ambient temperature range of 120 degrees F and a surface temperature of 160 degrees F.

B. Performance Requirements: Bear AMCA Certified Ratings Seal for air performance.

1.04 SUBMITTALS

A. Submittals for Review:

1. Supplied and installed by Mechanical Contractor ref. mechanical schedules.

2. Shop Drawings: Include locations, elevations, sections, dimensions, materials, finishes, attachment, and relationship to adjacent construction.

3. Samples: 3 x 3 inch coating samples showing available colors.

B. Quality Control Submittals:

1. Certificates of Compliance: AMCA licensed test data.

C. Sustainable Design Submittals:

1. Recycled Content.
2. Regional Materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Airline Products, Inc. (www.airlinelouvers.com)
2. Airolite Company. (www.airolite.com)
3. Construction Specialties, Inc. (www.c-sgroup.com)
4. Industrial Louvers. (www.industriallouvers.com)
5. Ruskin Co. (www.ruskin.com)

B. Substitutions: Under provisions of Division 01.

2.02 MATERIALS

A. Aluminum:

1. ASTM B221, 6063-T5 or T6 alloy and temper.

2. Recycled content: Minimum 75 percent, with minimum 40 percent classified as post consumer.

B. Insect Screen: 16 x 18 mesh aluminum.

2.03 COMPONENTS

A. Metal Louvers:

1. Type: Fixed blade.
2. Depth: 6 inches.
3. Blade angle: 45 degrees.
4. Blade spacing: 6 inches on center.
5. Blade profile: Drainable.
6. Performance requirements, based on 48 x 48 inch louver tested to AMCA 500.
    a. Free area: Minimum 50 percent.
7. Linkage: Concealed in frame.
8. Actuator: Electric, 24 VAC, two position, spring return.
9. Gutters: Drain gutters in each blade.
10. Downspouts: In each jamb.

2.04 ACCESSORIES

A. Fabricate frame from minimum 0.63 inch thick aluminum.

B. Fabricate blades from minimum 0.63 inch thick aluminum.

C. Fit components to hairline joints. Weld connections, with welds ground smooth and filled.

D. Join vertical mullions with l-shaped slip connection.

E. Fabricate horizontal mullions to appear as single louver.

F. Mount screen in rewireable U-shaped frame.

G. Provide metal sheeting of same material and finish as frame to blank out unused portions of louvers.

2.06 FINISHES

A. Aluminum: AAMA 611, Architectural Class I anodized to 0.0007 inch minimum thickness. Color by Architect.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions and approved Shop Drawings.

B. Set plumb, level, and rigid, with flush hairline joints.

C. Anchor to supporting construction.

D. Prevent contact of aluminum and dissimilar metals by use of zinc rich paint, bituminous coating, or non absorptive gaskets.

E. Install screen on inside face.

F. Install blank out sheeting over unused portions of louver.

G. Install wiring between power supply and operator and between operator and controls.

3.02 ADJUSTING

A. Touch up minor scratches and abrasions in prime and finish coat to match factory finish.

B. Adjust operable louvers for proper operation.

END OF SECTION 08 91 00
LOUVERS

SECTION 09 21 00

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gypsum board with taped and sanded joint treatment.

PART 2 PRODUCTS

2.01 GYPSUM BOARD SYSTEM

A. Manufacturers:

1. U.S.G.
2. Gold Bond.
3. Georgia Pacific Corporation.
4. National Gypsum Company.
5. Bestwall Gypsum Company/Donn Products, Inc.

B. Gypsum Board Types: 5/8 inch thick, maximum permissible length; ends square cut, tapered edges; unless noted otherwise as follows:

1. Fiberglass Reinforced Moisture Resistant Type: ASTM C603 for wall linings in all potentially wet locations, bathroom walls, kitchen walls, and to surface walls behind laundry machines and all exterior walls. (Fire rated at common walls between units and between unit and common space, i.e. Corridors and stairs.)
2. Standard paper faced at interior partitions within units.

2.02 ACCESSORIES

A. Corner Beads: At external corners, provide metal corner bead with smooth rigid nose and perforated and knurled metal flanges.

B. Fasteners: Type “W” size and spacing drywall screws in accordance with structural engineer’s notes. No drywall nails may be used.

C. Adhesive: ASTM C557 or GA 216 – Perf-A-Tape Compound.

D. Joint Reinforcement: Perf-A-Tape Compound.

PART 3 EXECUTION

3.01 INSTALLATION – GYPSUM BOARD

A. Install gypsum board in accordance with manufacturer's instructions in orientation required by UL rated assemblies.

B. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

C. Treat cut edges and holes in moisture resistant gypsum board with sealant.

3.02 JOINT TREATMENT

A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes – 3 coat application.

B. Feather coats onto adjoining surfaces so that camber is maximum 1/32 inch.

C. Finish to Level 4 for areas to be painted.

3.03 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet in any direction.

3.04 REPAIRS TO DRYWALL

A. Prior to painting, inspect all walls and ceilings throughout project unit kitchens, unit baths and common areas and repair/replace damaged drywall including screwl pops, nicks, damaged corners, cracked joints, water damaged areas, areas with broken drywall board, etc.

B. Finish to match adjacent walls or ceilings (texture, color, sheen, etc.)

END OF SECTION 09 21 00
GYPSUM BOARD ASSEMBLIES

SECTION 09 99 99

FINISHES

Paint

P1 – Typical Wall paint TYPE 1 Dwelling Units. Paint all walls this color unless otherwise shown on Enlarged Finish Plan in drawings.
BM #AF – 100, Pashima

P2 – Accent Paint – **BM#AF-405, Thicket**
P3 – Accent Paint – **SW#0009, Eastlake Gold**

P4 – Typical Ceiling Paint, Base Trim, HM Door Frames and Interior Face of Unit Entry Doors and other Doors within the Unit for both Type 1 and Type 2 Units.
And Typical Corridor Ceiling paint and pop down sprinkler heads.
BM#AF-10 Gardenia

P5 – Typical Wall paint TYPE 1 Dwelling Units. Paint all walls this color unless otherwise shown on Enlarged Finish Plan in drawings.
BM #AF-100, Pashima

P6 – Accent paint – **SW#0020, Peacock Plume**

P7 – Accent paint – **SW#6256, Serious Gray**

P8 – Corridor G02, 102, 202 Wall paint, Typical unless noted otherwise on drawings. **SW#0011, Crewell Tan**

P9 – Corridor G02,102,202 Accent paint – **SW#0043, Peristyle Brass**

P10 – Corridor G02,102,202 Base, Hollow Metal Frames and Doors, South Fire Exit Stair Handrails – **BM#AF-180, Wenge**

P11 – Corridor G01, 101, 201 Wall paints
P11a (Northernmost Sawtooth both sides of corridor), **PPG#149-1, First Light**
P11b (2nd from north Sawtooth and Janitor Closet Door and Frame),
PPG#149-2, Blue Booties
P11c (Middle Sawtooth), **PPG# 149-3, Sweet Dreams**
P11d (4th Sawtooth from North), **PPG#149-4, Windjammer**
P11e (Southernmost sawtooth nearest elevator), **PPG 149-5, Magical Merlin**

P12 –Corridor G01,101,201 Base and Hollow Metal frames, -
BM #AF-565, Mysterious
P13 – Unit Entry Doors, North Stairwell Door, Laundry Door –
BM #AF-630, Kalamata

Plastic Laminate

PLam1 - Formica # 3458-77, Travertine Silver
PLam 2 - Formica3450-58, Mineral Jet

Solid Surface

SS1 – Wilsonart Gibraltar #1531MG, Light Beige Mirage
SS2 – Wilsonart Gibraltar #9148RS, Riverstone

Carpet

CPT 1 – Typical Dwelling Units Types 1 and Type 2 Carpet Squares -
Bentley Prince Street – Satellite City # 8SC240630R
Color, Federal Hill. (Provide 15% attic stock in unopened cartons in Base Bid)

CPT 2 – Elevator Lobby and All Community Rooms – Bentley Prince Street – Clodagh's Natural State #8NL181639R, Broadloom over light pad, Tack down

CPT 3 – Corridors G02,102,202 – Bentley Prince Street, Functional Expression, Avant Gardia #8AD300630R, Broadloom over pad, Tack down Provide 24" border where indicated. Solid Color from within pattern, color by architect

CPT4 – Corridors G01,101,201 – Bentley Prince Street, Charles River #8CA32, Color: Middlesex #885938, Broadloom on light pad, Tack down

Porcelain Tile

CT1 – Type 1 Dwelling Units, Genesee Tile # UK2A Calatrata Pearl, Timeless Series 13 x 13 x 3/16, thinset over sealed gypsum concrete per TCA-F180-09. At supported concrete slab at Garden Level per TCA F131-09. provide waterproof membrane at bathrooms. Use Epoxy mortar and grout, .Maipai #14 Biscuit

CT2 – Type 2 Units and Entrance Lobby, Genesee Tile #A1L6, Focus Cenere. Focus Series, 12 x 12 x 3/16, this set over sealed gypsum concrete per TCA F180-09. At supported concrete slab art garden level per TCA 131-09. Provide waterproof membrane at bathrooms. Use epoxy mortar and grout, Maipai #11 Sahara Beige

Pedimat -- #7304 Sandstone Insert in Bronze Frame

END OF SECTION 09 99 99
FINISHES

SECTION 10 14 23

INTERIOR PANEL SIGNS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plastic interior panel signs.

B. Related Sections:

1. Division 01: Administrative, procedures, and temporary work requirements.

1.02 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings: Include sign locations, sizes, mounting heights, and content.

2. Samples:
   a. 3 x 3 inch sign samples showing available colors.
   b. After color selection, submit typical sign illustrating pictograms, characters, and Braille indications.

B. Sustainable Design Submittals:

1. Regional Materials.
2. Low-Emitting Materials.

1.03 QUALITY ASSURANCE

A. Conform to applicable accessibility code for sign design, construction, location, and mounting height.

B. Mockup:

1. Size: One full-size sign.
2. Approved mockup may not remain as part of the Work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. APCO Graphics, Inc. (www.apcosigns.com)
2. Best Sign Systems, Inc. (www.bestsigns.com)
3. Seton Identification Products. (www.seton.com)

B. Substitutions: Under provisions of Division 01.

2.02 MATERIALS

A. Signs:

1. Type: Melamine plastic laminate with contrasting color core, non static, fire retardant, self extinguishing, matte finish.
2. Thickness: 1/8 inch.
3. Face and core colors: To be selected from manufacturer's full color ranges.

2.03 ACCESSORIES

A. Adhesive:

1. Type recommended by sign manufacturer.
2. Maximum volatile organic compound (VOC) content: 70 grams per liter.

2.04 FABRICATION

A. Fabricate signs by reverse engraving process to produce characters and graphics in contrasting color, raised 1/32nd inch.

B. Characters:

1. Height: 5/8 inch.
2. Style: Sans serif style to be selected.
3. Width to height ratio: Between 3:5 and 1:1.
4. Stroke width to height ratio: Between 1:5 and 1:10.

C. Pictograms: Universal accessibility symbols, 6 inches high.

D. Provide Braille indications for each character.

E. Corners: ½ inch radius.

F. Edges: Square.

G. Border: None.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces of loose and foreign matter.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

B. Locate signs on wall adjacent to scheduled doors.

3.03 SCHEDULE

LOCATION	SIGN SIZE	CONTENT	
Unisex Toilet	6 x 6 inches	“UNISEX” and accessible symbol	x (1)
Elevator Lobby	6 x 6 inches	“ELEVATORS WILL NOT BE USED DURING EMERGENCY – USE FIRE STAIRS”	x (14)
Janitor Closet	4 x 4 inches	“JANITOR CLOSET”	x (1)
Community Room	6 x 6 inches	“COMMUNITY ROOM”	x (1)
Manager	6 x 6 inches	“MANAGER”	x (1)
Case Manager	6 x 6 inches	“CASE MANAGER”	x (1)
Customer Service	6 x 18 inches	“CUSTOMER SERVICE”	x (1)
Conference	6 x 6 inches	“CONFERENCE ROOM”	x (1)
Office	6 x 6 inches	“OFFICE”	x (1)
Lounge	6 x 6 inches	“LOUNGE”	x (2)

END OF SECTION 10 14 13
INTERIOR PANEL SIGNS

SECTION 10 44 33

FIRE CABINETS and EXTINGUISHERS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Fire Extinguishers

B. Cabinets

1.02 RELATED WORK

A. Field Painting

B. Fire Sprinkler Systems

1.03 REFERENCES

A. NFPA1 0-Portable Fire Extinguishers

B. UBC 43-6 (ASTM E814-83) – Fire rated cabinets fabricated in accordance to measure, restore, perform.

C. Americans with Disabilities Act 1990 on maximum cabinet projection of C in corridors where necessary.

1.05 SUBMITTALS

A. Submit brochure and product data in compliance with Division 01 Specification Sections.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Where shown on the drawings, provide fire extinguishers, cabinets, accessories manufactured by J. L. Industries, Inc., 4450 West 78th Street Circle, Bloomington, MN 55435, (952) 835-6850.

2.02 FIRE EXTINGUISHERS

A. Dry Chemical Type: J. L. Industries Cosmic or Galaxy Series.

2.03 FIRE EXTINGUISHER CABINETS

A. Where indicated on drawings, provide J.L.'s Aluminum Panorama, Fire FX1027V10 with 3" rolled-edge trim and 2A10BC Fire Extinguisher. Provide keyed lock. All cabinets to be keyed the same.

B. Provide cabinets with fire-rated option, if applicable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.

2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

END OF SECTION 10 44 33
FIRE CABINETS and EXTINGUISHERS

SECTION 10 55 13

MAILBOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. 4C Horizontal Mailboxes

1. Front-loading interior mailboxes.

1.02 RELATED SECTIONS

A. Wood Framing: Framed wall openings to receive mailboxes.

B. Gypsum Board.

1.03 REFERENCES

A. United States Postal Service (USPS):

1. USPS-STD-4C: United States Postal Service Standard 4C, Wall-Mounted Centralized Mail Receptacles.

2. USPS Publication 16.

B. Architectural and Transportation Barriers Compliance Board (ATBCB): Americans with Disabilities Act Accessibility Guidelines (ADAAG) for Buildings and Facilities.

C. ASTM A 666 – Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. ASTM B 209 – Specification Aluminum and Aluminum Alloy Sheet and Plate.

E. ASTM B 221 – Specification Aluminum and Aluminum Alloy Extruded Bar, Rods, Wire, Shapes, and Tubes.

1.04 SUBMITTALS

A. Submit under provisions of Division 01 Specification Section.

B. Product Data: Manufacturer’s data sheets on each product to be used, including:

1. Construction details, material descriptions, dimensions, and finishes.

2. Preparation instructions and recommendations.

3. Storage and handling requirements and recommendations.

4. Installation methods.

C. Shop Drawings: Prepared specifically for this project; show dimensions of mailboxes, wall cuts, and interface with other products.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 2 inches (50 mm) square, representing actual color and texture.

1.05 REGULATORY REQUIREMENTS

A. Comply with USPS-STD-4C for wall-mounted centralized mailboxes.

B. Comply with Americans with Disabilities Act Accessibility Guidelines (ADAAG).

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have a Quality System in place to ensure and be able to substantiate that manufactured units conform to requirements and match the approved design and must be ISO 9001:2008 certified.

1.07 DELIVERY, STORAGE AND HANDLING

A. Inspect the materials upon delivery to ensure that specified products have been received.

B. Store materials protected from exposure to harmful weather conditions.

C. Handle materials to prevent damage or marring of finish.

1.08 WARRANTY

A. Manufacturer's standard warranty to repair or replace components of postal specialties that fail in materials or workmanship within one year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Salsbury Industries, 1010 East 62nd Street; Los Angeles, CA 90001-1598; Toll Free Tel: 800-MAILBOX (800-624-5269); Fax: 800-624-5299; Email: salsbury@mailboxes.com; Web: www.mailboxes.com.

B. Requests for substitutions will be considered in accordance with provisions of Division 01 Specification Section.

2.02 WALL-MOUNTED CENTRALIZED MAIL RECEPTACLES – HORIZONTAL MAILBOXES

A. USPS Approved Front-Loading Mailboxes: Horizontal style complying with USPS-STD-4C as manufactured by Salsbury Industries consisting of multiple compartments enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from front of unit with accessibility to

entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.

1. Model: 3700 Series
    a. Module: 3716D-20 AFU

2. Mounting: Recessed mounted

3. Locks: USPS-1172 910A, 3 keys each lock

4. Box Identification:
    a. Engraved Identifier

5. Mail Distribution:
    a. Mail Distribution: USPS

6. Material and Finish: Aluminum with powder coated finish
    a. Color: Aluminum – standard

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings in wall are correctly located, aligned, and sized for mailboxes.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.04 CLEANING

A. Clean surfaces with mild dish detergent. Do not use harsh abrasive cleaners. Lubricate locks with graphite type lubricants only.

3.05 PROTECTION OF INSTALLED PRODUCTS

A. Protect finishes from damage by construction activities.

END OF SECTION 10 55 13
MAILBOXES

SECTION 11 30 00

APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This work consists of furnishing all appliances indicated on the drawings, in accordance with the accompanying drawings and these specifications. Such appliances consist of ranges, range hoods, heat shields, and refrigerators. All appliances to be white.

B. The following work is not included in this section of the specifications:

1. Garbage Disposals (Div. 22 41 00).

1.02 QUALITY ASSURANCE

A. This trade shall prepare completely detailed manufacturer's cut sheets showing all items to be provided under this section of the specifications and shall submit them to the Architect for approval.

B. This trade shall verify and coordinate appliance dimensions and clearance requirements with this work in order to assure proper fitting together of all cabinets and equipment, and to allow for proper operation of same.

C. In all units designated for the use of the Physically Handicapped, modifications shall be made in order to accommodate their requirements as specifically listed below.

D. In barrier-free units switches and controls required for normal operation shall be located no more than 48" above the floor, no less than 30" above the floor, and at the front or side of the electrical unit to be controlled.

E. Units listed below are Whirlpool models. Other manufacturer's models will be considered upon submittal of shop drawings to the Architect.

PART 2 PRODUCTS

2.01 REFRIGERATOR

A. Refrigerator: 14 cu Frost-Free, no ice-maker, freezer over refrigerator, Energy Star rated and compliant. Color: Clean Steel.

2.02 RANGE

A. Electric Range (Typical Unit): Standard sized 30" with four (4) ceramic tip infrared burners, cooktop over electric oven with front controls. Color: Stainless Steel.

2.03 RANGE HOOD: Energy Star Rated 30 inch wide recirculating hoods with charcoal filters. Units to include 2 speed fan, light switches. Color: Stainless Steel.

2.04 HEAT SHIELD: Plastic Laminate. Provide behind range – full width of range and full height from bottom of hood or microwave hood to behind range back. Color to match Countertop.

2.05 Bath Fan: Broan Model F770, 50 CFM, 1.5 sones, 4" Round Duct. Energy Star Rated or Equivalent.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Remove existing appliances being replaced and properly dispose of off site.

B. Verify that openings and utility services are ready to receive work and opening dimensions are as instructed by the manufacturer.

C. Receive all equipment free from damage and blemishes.

3.02 INSTALLATION

A. Deliver to site, uncrate, dispose of debris, and set all appliances in place in the appropriate living units.

B. Install equipment in accordance with manufacturer's instructions.

C. Set and adjust units level and plumb.

D. Activate units to confirm correct operation.

E. Coordinate work with Divisions 22 and 26.

F. Connect to utilities and make units operational.

G. Provide operation and maintenance manuals to Owners covering use and operation of all equipment.

H. Prior to final inspection, clean all equipment thoroughly.

I. Submit one copy of the manufacturer's warranty on all appliances. Such warranties are to carry a complete listing of all serial numbers of the specific appliances to which they apply.

3.03 LOCATION

A. All units and Neighborhood Network Center kitchenette.

END OF SECTION 11 30 00
APPLIANCES

SECTION 12 32 00

KITCHEN and BATH CABINETS and COUNTER TOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cabinets – replace.

B. Countertops and connections to walls (for all wood casework) – replace.

1.02 QUALITY ASSURANCE

A. Specifications establish the standards of quality required for all casework.

B. Comply with requirements of KCMA as a minimum.

1.03 SUBMITTALS

A. Provide two (2) samples of finish for approval by the Owner and Architect.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers

1. Cabinets: Smart Cabinets. Color: Per Section 09 99 99 Finishes.
    a. Species: Maple.

2. Countertops: Square edge. Plastic laminate covered.

B. Cabinets

1. Made in an established, properly equipped, shop which specialized in such work.

2. Cabinet Hardware: Selected by Designer from manufacturer's standard.

C. Countertops, Backsplashes and Edging: L-P-508 satin finish decorative general purpose HP-high pressure Class 1, plastic sheet 1/16 inch thick.

1. Backing Sheets: Where required to reduce warp; L-P-508 HP-high pressure at least 0.20 inch thick.

2. Counter core: Not less than ¾ inch thick plywood, sanded 2 sides, exterior type, grade AC face species producing minimum grain rise, PS 1, or not less than ¾ thick particle board CS 236, Type 2, medium density, Class 1.

3. Backsplashes: Splashes as noted in Interior Finishes Notes of plastic laminate. Provide at all junctions of vertical surfaces.

4. Color selection: As noted in Section 09 99 99 Finishes.

5. Completed counter assembly: Conform to applicable requirements of L-T00041, Type 1, where not inconsistent with these specifications.

PART 3 EXECUTION

3.01 FABRICATION

A. Remove and properly dispose of cabinets and countertops off site.

B. Countertop and work surface plastic sheets shall be bonded to cores in conformance with applicable test and requirements for Type II, water-resistant bond in L-T-0041.

C. Finished kitchen cabinets shall provide the following features irrespective of materials and design:

1. Toe space 3 inches x 4 inches. (Typical.) At B.F. Units use 34” high cabinets with 9” raised toe space. Provide bases to match cabinets.

2. Water-resistant joints in countertops and between countertops and backboard and at least as strong as a tight T & G joint with urea or resorcinol glue.

3. Ease all edges of exposed corners.

4. Operation of any movable part (doors, drawers, boards, shelves, etc.) Shall not produce noises in excess of a well designed and built all-wood cabinet.

D. Finished kitchen cabinets shall be capable of supporting normal anticipated loadings.

E. Cabinets to be factory finished.

F. Prior to final inspection, clean all equipment thoroughly.

3.02 INSTALLATION

A. Protect all casework during and after delivery to the project site against damage.

B. Un-crate, set up, place, level scribe and anchor all cabinets in accordance with manufacturer’s recommendations.

C. Provide all necessary fillers, panels, end panels, scribes required to make complete installation as detailed.

D. All finishes must be smooth, uniform in color, and match approved samples.

3.03 LOCATION

A. All Units – Kitchens and Baths.

END OF SECTION 12 32 00
KITCHEN & BATH CABINETS & COUNTER TOP

SECTION 12 48 13

ENTRANCE FLOOR MATS and FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. This section includes the following types of entrance flooring systems.

1. Floor mats and frame assemblies.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. The Aluminum Association

C. The Carpet and Rug Institute (CRI)

D. The National Floor Safety Institute (NFSI)

1.03 SUBMITTALS

A. General: Submit the following in accordance with conditions of contract and Division 01 specification.

B. Product data for each type of floor mat and frame specified including manufacturer's specifications and installation instructions.

C. Shop drawings in sufficient detail showing layout of mat and frame specified including details indicating construction relative to materials, direction of traffic, spline locations, profiles, anchors, and accessories.

D. Samples for verification purposes: Submit an assembled section of floor mat and frame members with selected tread insert showing each type of color for exposed floor mat, frame and accessories required.

E. Maintenance data in the form of manufacturer's printed instructions for cleaning and maintaining floor mats.

1.04 QUALITY ASSURANCE

A. Flammability in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/m^2.

B. Slip resistance in accordance with ASTM D-2047-96, Coefficient of Friction, minimum 0.60 for accessible routes.

C. Standard rolling load performance is 350 lb./wheel with larger loading requirements as specified (load applied to a solid 5" x 2" wide polyurethane wheel, 1000 passes without damage.)

D. Single Source Responsibility: Obtain floor mats and frames from one source of a single manufacturer.

E. Utilize superior structural aluminum alloy 6063-T6 for rail connectors.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the project site ready for use and fabricated in as large sections and assemblies as practical, in unopened original factory packaging clearly labeled to identify manufacturer.

1.06 PROJECT CONDITIONS

A. Field measurements: Check actual openings for mats by accurate field measurements before fabrication. Record actual measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

B. For recess application coordinate frame installation with concrete construction to ensure recess and frame anchorage are accurate and that the base is level and flat. Defer frame installation until building enclosure is complete and related interior finish work is in progress.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Drawings and specifications are based on manufacturer's literature from Construction Specialties, Inc. unless otherwise indicated. Other manufacturers must comply with the minimum levels of material and detailing indicated on the drawings and specified herein.

2.02 MATERIALS

A. Architectural Bronze – ASTM B 455, copper/zinc alloy C38500 for extrusions.

B. Tread insert options – refer to section 2.05.

2.03 FLOOR MATS

A. Model and Description – M1 Pedimat. Exposed hinge rail connects shall be extruded 6063-T6 aluminum. (Optional C380 architectural bronze available). Complete with perforations for drainage. Tread rails shall be manufactured from high-impact vinyl/acrylic, complete with co-extruded soft-durometer cushions. Choose from anodized of heavy-duty powder coat finish. Color: Bronze.

2.04 MAT FRAMES

A. Frame as required based upon adjacent flooring.

2.05 TREAD INSERT OPTIONS

A. HD – MonoTuft HD^{TM} Carpet shall meet CRI standard for good indoor air quality. Fibers shall include a minimum of 100, 12 mil monofilament fibers per square inch.

Each carpet fiber and monofilament shall be fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice-free lengths. Anti-static carpet fibers shall contain antimicrobial additive and be treated with Scotchgard® to reduce soiling. Carpet weight shall be 33-oz./yd^2. Color: Pewter.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

3.02 PREPARATION

A. Manufacturer shall offer assistance and guidance to provide a template of irregular shaped mat assemblies to ensure a proper installation.

3.03 INSTALLATION

A. Install the work of this section in strict accordance with the manufacturer's recommendations.

B. Set mat at height recommended by manufacturer for most effective cleaning action.

C. Coordinate top of mat surface with bottom of doors that swing across to provide ample clearance between door and mat.

3.04 CLEANING

A. It is important to the life cycle of the entrance mat that a maintenance schedule be developed which includes regular vacuuming and extraction that correctly matches the amount of traffic the mat incurs.

3.05 PROTECTION

A. After completing required frame installation and concrete work, provide temporary filler of plywood or fiberboard in recess, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and project is near time of substantial completion.

B. Defer installation of floor mats until time of substantial completion of project.

END OF SECTION 12 48 13
ENTRANCE FLOOR MATS and FRAMES

SECTION 14 21 00

TRACTION ELEVATORS

DESCRIPTION

This Specification is intended to cover the complete installation of one gearless traction passenger elevator.

All work will be performed in a workmanlike manner and is to include all work and material as specified herein. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference will apply to as many such devices as are required to complete the installation.

WORK PROVIDED BY OTHERS

Ventilation and temperature control of elevator equipment room.

Electrical service to the main line disconnect in elevator machine room.

Machine room and pit receptacles with ground-fault current protection.

Lighting in machine room and pit.

Wiring for telephone service to machine room.

QUALITY ASSURANCE

All work will be performed in accordance with applicable building codes and ASME/ANSI A17.1, 2007 Safety Code for Elevators and Escalators.

PERMITS, TAXES AND LICENSES

All applicable sales and use taxes permit fees and licenses, at the date bids are taken, will be paid for by the elevator contractor.

GUARANTEE

The elevator contractor will guarantee the materials and workmanship of the apparatus furnished by him under these specifications and he will make good any defects not due to ordinary wear and tear or improper use or carelessness which may develop within one (1) year from date of completion of each elevator.

APPROVED SUPPLIERS

Only Suppliers named for the various components listed below are to provide the equipment for this project. No substitutions will be accepted.

SYSTEM DESCRIPTION:

I.D.	Commerce Street	
Quantity:	One	(1)
Type:	Permanent Magnet AC ~~Gear~~less Machine	
Number of stops/openings:	Four in line	
Speed:	150 feet per minute	
Travel:	40’ approximate	
Rated Capacity:	3500 lb.	
Main Power Supply:	208 volts, 3 phase, 60 cycle	

SCOPE

CONTROLLER AND MOTOR DRIVE

Provide new VVVF Vector (Closed Loop) AC Drive Gearless Overhead Traction controller and motor drive. Approved suppliers include:

1) Virginia Controls Model VF3000MRL
2) Motion Control Engineering Model 4000MRL

Include necessary starting switches together with all relays, switches, solid-state components and hardware required for operation, including door operation, as described herein. Provide magnetic tape selector hoistway package.

Fire service Phase I emergency recall operation, alternate level Phase I emergency recall operation, and Phase II emergency in-car operation shall be provided. The activation of a key switch in a lobby level hall station shall return the car express to the designated floor, by-passing all car and hall calls. The car shall park at the designated floor with the doors open and will not respond to car or hall calls unless the Phase II switch in the car is activated.

All machine room control equipment will carry the NEMA 1 Rating.

TRACTION MACHINE

Install new permanent magnet AC gearless traction hoist machine from Hollister Whitney Elevator Corporation.

HOIST ROPES

Install new traction steel hoist cables with approved wedge type rope shackles.

GOVERNOR

Install new overspeed governor and tension weight assembly, with new traction steel cable.

WIRING

Provide and install complete new hoistway and machine room wiring and car traveling cable. All wiring and electrical interconnections shall comply with the governing codes. Insulated wiring shall have flame retardant and moisture-proof outer covering, and shall be run in conduit tubing or electrical wireways.

CAB

Supply complete new cab as described below. Cab is 8' 0" high clear to underside of canopy.

Front returns and doors:	14 ~~gauge~~ steel painted with enamel finish in color of Owners selection. Standard returns with surface mounted car operating fixtures.
Walls:	Raised plastic laminate panels with black plastic laminate reveals, frieze and base
Handrail:	No. 4 stainless steel 2" wide handrail at two side walls
Canopy:	12 gauge steel painted with white enamel finish.
Drop ceiling/Lighting:	Recessed fluorescent light fixtures above aluminum frame ceiling with acrylic diffusers
Flooring:	Allow for 1/2" recess for carpet provided by others aluminum

DOOR OPERATOR

Provide complete door operating equipment package from GAL Manufacturing Corp. Provide new car door operator Model MOVFR. Provide accessory car door clutch and linkage, car door interlock, and car door hanger assemblies with new door track.

Provide complete new door operating equipment for the elevator landings. Provide hoistway door closers, door locks, door hanger assemblies and door tracks at all floors.

HOISTWAY ENTRANCE ASSEMBLIES

Install complete UL Rated hoistway landing entrance assemblies including doors, frames, headers, struts, sills, sill supports, struts and fascia. Include two (2) gibs for each door panel. The hoistway rough opening will be 3'-10" x 8'-4". The Hoistway Assembly shall include 3'-6" x 7'-0" doors and a 1'-0" offset transom to match the material and finish of the doors. Doors are to be supplied with painted finish in color of Owners choice.

CAR TOP STATION

Provide new car top operating station with emergency alarm bell with NEMA 4 Rating.

CAR TOP HANDRAIL

Provide railings complying with ASME A17.1/CSA B44 on car tops

PIT BUFFERS

Install new buffer assemblies and pit channels suitable for the application.

CAR AND COUNTERWEIGHTS

Install new car sling and platform assembly.

Install complete new counterweight frame and new steel counterweight filler weights

SAFETIES

Install new flexible guide clamp car safeties from Hollister Whitney Elevator Corporation.

CAR AND COUNTERWEIGHT GUIDE RAILS

Install new guide rails for car and counterweight, including all necessary brackets, hardware and fishplates.

CAR AND COUNTERWEIGHT ROLLER GUIDES

Install new car roller guide assemblies Model No. 378 from Hollister Whitney Elevator Corporation.

Install new counterweight roller guide assemblies Model No. 377 from Hollister Whitney Elevator Corporation.

SIGNAL DEVICES AND FIXTURES

Signal Devices and Fixtures shall be provided by Innovation Industries, heavy duty “Bruiser Series”.

Car-Operating Panel: A panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. Raised markings shall be provided for each push-button. Applied car operating panel shall be furnished. It shall contain a bank of mechanical illuminated buttons marked to correspond to the landings served, an emergency call button, door open and door close buttons. Provide keyed switches for lights, inspection, stop switch and the exhaust fan.

Car Position Indicator: A 2" dot-matrix digital car position indicator shall be integral with the car-operating panel. The controller shall have a position indicator output to drive the required position indicator which shall indicate the corresponding floor numbers as the car passes or stops at a floor. An audible signal shall sound as the position indicator changes floors.

Hall Pushbutton Stations: Hall call station fixtures shall be provided at all landings with necessary push buttons and fire service key switches and engraved instructions for proper elevator operation, including fire recall and "Appendix H" exiting . Include hoistway access key switches at the top and bottom landings.

Telephone Cabinet: A telephone compartment shall be furnished integral with the car-operating panel. Necessary wires for the telephone shall be included in the compartment and connected to the car traveling cable. Supply new ADA compliant hands free phone.

CLEAN UP

Remove daily trash from hoist-ways, pits and machine rooms including all packing material and debris resulting from this work. Leave all elevator spaces broom clean. All elevator equipment not painted, wire duct, miscellaneous iron and steel work located within the machine room or hoist-way shall be given a finished coat of paint. Material that has factory finish paint shall have all scratches or mars painted after installation. Finished coats shall have hard, tough semi-gloss surface.

PERFORMANCE

Speed: +/- 5% under any loading condition.
Capacity: Safely lower, stop and hold up to 125% rated load.
Leveling: +/- ¼" under any loading condition.
Doors: Closing time, Thrust and Kinetic Energy shall comply with ASME Code and ADA.

CLOSE-OUT

Contractor must submit all hardware, software and written information necessary for the complete maintenance, troubleshooting, re-programming and adjustment of the equipment prior to final acceptance as listed below. All items will become the property of Consumers Energy.

1) Laptop computer with uninhibited access to the controller capable of monitoring, troubleshooting, re-programming and adjusting the elevator in every aspect.

2) CD copy of operating control program.

3) Straight line wiring diagrams of as-installed elevator circuits with index of location and function of all components. Leave one laminated set in machine room. Provide 2 corrected sets for Consumers Energy files

4) Lubricating instructions and recommended lubricant grade.

5) Two (2) copies of the parts catalog and maintenance manuals.

END OF SECTION 14 21 00
TRACTION ELEVATORS

SECTION 21 13 00

WET/DRY PIPE FIRE SUPPRESSION SYSTEM

PART 1 GENERAL

1.00 WORK PROPOSAL

The bid for Fire sprinkler system shall be furnished directly to G.C. The Sprinkler contractor shall coordinate directly with the 22, 25, and 26 trades to complete a fully operable system.

1.01 WORK INCLUDED

A. This Section specifies automatic sprinkler systems for buildings and structures. Materials and equipment specified in this Section include:

Pipe, fittings, valves, and specialties.
Sprinklers and accessories.

B. When structure configuration and code requires a dry system shall be installed for all or partial areas of the building. All items to produce a full and operating system shall be included.

1.02 SUBMITTALS

A. Product Data for each type of sprinkler, valve, piping specialty, fire protection specialty, fire department connection specified.

B. Furnish scale drawings of entire system for submission to authorities having jurisdiction.

1.03 QUALITY ASSURANCE

A. Qualifications:

Installation and alterations of fire protection piping, equipment, specialties, and accessories, and repair and servicing of equipment shall be performed only by a qualified installer.

B. Regulatory Requirements:

Comply with the requirements of the following codes:

NFPA 13 - Standard for the Installation of Sprinkler Systems.

UL Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled.

C. Approvals:

1. Obtain permits and approvals from the authority having jurisdiction, as required.

2. Contractor shall provide hydraulic design criteria, density information and sprinkler

installation/documentation, and obtain approval from the State Fire Marshall's office in accordance with Act 07 and as amended by Act 144.

PART 2 PRODUCTS

2.01 PIPE

A. Steel Pipe:

ASTM A 120, Schedule 40, seamless, black steel pipe, plain ends.

B. Steel Pipe:

ASTM A 120, Schedule 10, seamless, black steel pipe, plain ends.

C. CPVC Pipe:

CPVC Sprinkler pipe to conform to the requirements of ASTM F443 and carries the markings of Underwriters Laboratories Inc. (UL & C-UL), and Factory Mutual (FM). Vertical pipe and pipe within fire rated areas to be steel.

D. Grooved Piping: Steel Pipe: ASTM A 120, Schedule 10 black steel pipe with grooved ends. All grooves must meet manufacturer's specifications.

2.02 FITTINGS

A. Cast-Iron Threaded Fittings:

ANSI B16.4, Class 250, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

B. Cast-Iron Threaded Flanges:

ANSI B16.1, Class 250, raised ground face, bolt holes spot faced.

C. CPVC Fittings:

CPVC sprinkler fittings to conform to the requirements of ASTM F438, ASTM F439, and ASTM F1970. Fittings to carry the markings of Underwriters Laboratories Inc. (UL & C-UL), and Factory Mutual (FM). Female threaded adapters for sprinkler head connections shall contain brass inserts.

D. Couplings & Fittings for Grooved Piping System

1. Ductile Iron Grooved End Fittings & Couplings: All products must be of one domestic manufacturer. All products must be manufactured of ASTM A 536 ductile iron. Approved manufacturers: Victaulic FireLock.

2. Plain End Pipe: Victaulic Pressfit & FIT system are approved for all 2" and smaller piping in lieu of threading.

2.03 VALVES

A. Gate Valves - 2 Inches and Smaller:

Body and bonnet of cast bronze, 175 pound cold water working pressure - non-shock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open.

B. Double Check Valve Assembly:

Bronze body construction, replaceable seats, ball valve test cocks, Watts Series 709 or approved equal.

C. Valves for Grooved Piping System

1. Grooved Butterfly Valves: Ductile iron body, UL, Victaulic 708's or engineer approved equal.

2. Grooved Check Valves: Ductile iron body, UL, Victaulic 717 or engineer approved equal.

2.04 AUTOMATIC SPRINKLERS

A. Sprinklers:

Fusible link type, and style as indicated or required by the application. Unless otherwise indicated, provide sprinklers with nominal 1/2 inch discharge orifice, for "Ordinary" temperature range.

B. Sprinkler Finishes:

Provide sprinklers with the following finishes:

Upright, Pendent, and Sidewall Styles:

Chrome plated in finish spaces, exposed to view; rough bronze finish for sprinklers in unfinished spaces and not exposed to view.

2.05 DRY SYSTEM COMPONENTS

A. Equipment:

Materials and equipment as required include:

- Air Compressor
- Dry valve
- Air Maintenance device
- Accelerator
- Pressure switch
- Monitoring of control valves.

PART 3 EXECUTION

3.01 PIPING INSTALLATIONS

A. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.

B. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

C. Install unions in pipes 2 inches and smaller, adjacent to each valve.

D. Hangers and Supports:

Comply with the requirements of NFPA 13.

3.02 VALVE INSTALLATIONS

A. General:

Install fire protection specialty valves, fittings, and specialties in accordance with the manufacturer's written instructions, NFPA 13, and the authority having jurisdiction.

3.03 SPRINKLER INSTALLATIONS

A. Provide automatic sprinklers of type indicated on Drawings, and in accordance with the following listing. Provide fusible links for 165 degrees F (74 degrees celsius) unless otherwise indicated.

1. Upright, in areas without lay in ceiling.
2. Pendent, in lay in ceilings.

B. Install Spare Sprinkler Cabinet:

Install cabinet containing spare sprinkler heads and appropriate wrench (es) per NFPA 13.

3.04 FIELD QUALITY CONTROL

A. Flush, test, and inspect sprinkler piping systems in accordance with NFPA 13.

B. Replace piping system components which do not pass the test procedures specified, and retest repaired portion of the system.

END OF SECTION 21 13 00
WET/DRY PIPE FIRE SUPPRESSION SYSTEM

NOTE: THESE SPECIFICATIONS ARE THE PROPERTY OF THE ENGINEER AND ARE NOT TO BE REUSED OR REPRODUCED WITHOUT WRITTEN PERMISSION. THIS SPECIFICATION IS COPYWRITTEN.

SECTION 22 11 16

PLUMBING PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Pipe and pipe fittings.

B. Valves.

C. Sanitary sewer piping system.

D. Domestic water piping system.

E. Natural gas piping system.

1.02 RELATED WORK

A. Architectural - Earth Work.

B. Section 23 07 00 - Piping Insulation.

C. Section 22 40 10 - Plumbing Specialties.

1.03 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with [ANSI/ASME Sec 9.] [ANSI/AWS D1.1.]

1.04 SUBMITTALS

A. Submit product data under provisions of Section 23 00 00.

PART 2 - PRODUCTS

2.01 SANITARY SEWER AND STORM WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. PVC Pipe: ASTM D3033 or D3034, SDR 35. Fittings: PVC. Joints: ASTM F477, elastomeric gaskets.

2.02 SANITARY SEWER AND STORM WATER PIPING, BURIED AND ABOVE GRADE, BUT CONCEALED WITHIN BUILDING

A. PVC Pipe: ASTM D2665, D3034. Fittings: PVC. Joints: ASTM D2855, solvent weld.
NOTE: Concealed is defined as a pipe that is contained within a wall or in a fire rated

chase.

2.03 SANITARY SEWER AND STORM WATER PIPING, ABOVE GRADE (In Exposed Areas)

A. **Provide an Alternate only**. PVC Pipe: ASTM D2665, D3034. Fittings: PVC. Joints: ASTM D2855, solvent weld. If used in exposed areas, piping must be covered with minimum 1" fiberglass insulation with approved fire resistance rating. **NOTE:** Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling.

B. Cast iron pipes **(in exposed areas & on vertical installations)**: ASTM A74; C1SP1 301.
NOTE: Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling.

2.04 WATER PIPING, BURIED

A. Copper Tubing: ASTM B75 or B88 or B251, Type K, annealed temper. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: 95.5% tin, 4% copper, .5% silver "lead free" solder.

2.05 WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B75 or B88 or B251, Type L, hard drawn. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: 95.5% tin, 4% copper, .5% silver "lead free" solder.

2.06 NATURAL GAS PIPING ,BURIED BEYOND 5 FEET OF BUILDING

A. Gas Company to install and furnish material to bring gas service to building.

2.07 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53 or A120, Schedule 40 black. Fittings: ANSI/ASME B16.3, malleable iron, or ASTM A234, forged steel welding type. Joints: Screwed for pipe two inches and under; ANSI/AWS D1.1, welded, for pipe over two inches, welded in concealed locations for all sizes.

B. Test Criteria: Gas piping shall be tested with air or an inert gas. System to be tested to a pressure of 1-1/2 times the system working pressure, but not less than 3 psi. Piping system shall maintain the full-test pressure for a period of 10 minutes.

C. Piping in concealed locations shall not have unions, fittings, or threads.

2.08 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; neoprene gaskets for gas service; 1/16 inch thick preformed neoprene bonded to asbestos.

C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage

and lock, designed to permit some angular deflection, contraction, and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.09 GATE VALVES

A. Up to 2 Inches: Bronze body, rising stem and handwheel, inside screw, double wedge or disc, solder.

B. Over 2 Inches: Iron body, bronze trim, rising stem and handwheel, OS&Y, double wedge, flanged ends.

2.10 GLOBE VALVES

A. Up to 2 Inches: Bronze body, rising stem and handwheel, inside screw, renewable composition disc, solder screwed ends, with backseating capacity.

B. Over 2 Inches: Iron body, bronze trim, rising stem and handwheel, OS&Y, plug-type disc, flanged ends.

2.11 BALL VALVES

A. Up to 2 Inches: Bronze body, stainless steel ball, Teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.

B. Over 2 Inches: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle.

2.12 GAS COCKS

A. Up to 2 Inches: Bronze body, bronze tapered plug non-lubricated, Teflon packing, threaded ends.

B. Over 2 Inches: Cast iron body and plug, non-lubricated, Teflon packing, flanged ends.

2.13 SWING CHECK VALVES

A. Up to 2 Inches: Bronze 45 degree swing disc, screwed ends.

B. Over 2 Inches: Iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.

2.14 SPRING LOADED CHECK VALVES

A. Iron body, bronze trim, spring loaded, renewable composition disc, screwed, wafer, or flanged ends.

B. Over 2 Inches: Cast iron body, bronze fitted, elastomer diaphragm and seat disc, flanged.

2.15 ACCEPTABLE MANUFACTURERS

A. Nibbco, Red and White, Grinnell, and Substitutions: Under provisions of Section 230000.

2.16 ACCEPTABLE MANUFACTURERS - RELIEF VALVES

A. Watts.

B. Substitutions: Under provisions of Section 23 00 00.

2.17 RELIEF VALVES

A. Bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside.

C. Prepare piping connections to equipment with unions.

3.02 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

B. Provide access where valves and fittings are not exposed. {Coordinate size and location of access doors with Section 23 00 00.

C. Slope water piping and arrange to drain at low points.

D. Establish elevations of buried piping outside the building to ensure not less than minimum cover by code.

E. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

F. Prepare pipe, fittings, supports, and accessories not finished, ready for finish painting. Refer to Section 230000.

G. Establish invert elevations, slopes for drainage to 1/8 inch per foot one percent minimum. Maintain gradients.

H. Install bell and spigot pipe with bell end upstream.

I. Install valves with stems upright or horizontal, not inverted.

3.03 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install globe valves for throttling, bypass, or manual flow control services.

F. Provide spring loaded check valves on discharge of water pumps.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601.

I. Results shall be written up in a report and submitted to both the General trades contractor and Engineer. Results to also be submitted to health department if/as required by code.

END OF SECTION 22 11 16
PLUMBING PIPING

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SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Water heaters.

B. Pumps.

1.02 RELATED WORK

A. Section 23 00 00 - Mechanical General Provisions

B. Section 23 05 00 - Basic Mechanical Materials and Methods

C. Section 23 05 29 - Supports and Anchors.

D. Section 23 05 48 - Vibration Isolation.

1.03 REFERENCES

A. ANSI/ASME Section 8D - Pressure Vessels.

B. ANSI/NFPA 30 Flammable and Combustible Liquids Code.

C. ANSI/NFPA 70 - National Electrical Code.

1.04 QUALITY ASSURANCE

A. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

B. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. American Gas Association (AGA).

2. National Sanitation Foundation (NSF).

3. American Society of Mechanical Engineers (ASME).

4. National Electrical Manufacturers' Association (NEMA.)

5. Underwriters Laboratories (UL).

C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.05 REGULATORY REQUIREMENTS

A. Conform to AGA, NSF, NBBPVI, ANSI/NFPA 54, ANSI/NFPA 58, ANSI/NFPA 70, UL 174, ANSI/UL 1453 requirements for water heaters.

B. Conform to ANSI/ASME Section 8D, ANSI/NFPA 30, ANSI/NFPA 31 for tanks.

1.06 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 00 00.

B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.

C. Indicate pump type, capacity, power requirements and affected adjacent construction.

D. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

E. Submit manufacturer's installation instructions under provisions of Section 23 00 00.

F. Submit manufacturer's certificate under provisions of Section 23 00 00 that pumps meet or exceed specified requirements.

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D. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

E. Submit manufacturer's installation instructions under provisions of Section 23 00 00.

F. Submit manufacturer's certificate under provisions of Section 23 00 00 that pumps meet or exceed specified requirements.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 23 00 00.

B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 23 00 00.

B. Store and protect products under provisions of Section 23 00 00.

C. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.09 WARRANTY

A. Provide five year manufacturer's non-prorated warranty under provisions of Section 23 00 00.

B. Warranty: Include coverage of domestic water heaters and in-line circulators.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - IN-LINE CIRCULATOR PUMPS

A. Bell & Gossett

B. Substitutions: Under provisions of Section 23 00 00.

2.02 IN-LINE CIRCULATOR PUMPS

A. Casing: Bronze, rated for 125 psig working pressure.

B. Impeller: Bronze.

C. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

D. Seal: Carbon rotating against a stationary ceramic seat.

E. Drive: Flexible coupling.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's instructions and to AGA, NSF, NFPA, UL requirements.

B. Coordinate with plumbing piping and related gas venting and electrical work to achieve operating system.

3.02 PUMP INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide air cock and drain connection on horizontal pump casings.

C. Provide line sized gate valve and strainer on suction and line sized soft seated check valve and globe valve on discharge.

D. Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

E. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION 22 30 00
PLUMBING EQUIPMENT

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SECTION 22 41 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Water closets, Urinals, Lavatories, Sinks, Service Sinks, and Electric Water Coolers.

1.02 RELATED WORK

A. Architectural Spec. Section - Custom Casework: Preparation of counters for sinks.

B. Architectural Spec. Section - Joint Sealers: Seal fixtures to walls and floors.

C. Architectural Spec. Section - Toilet and Bath Accessories: Lavatory tops.

D. Section 23 05 29 - Anchors and Supports.

E. Section 22 11 16 - Plumbing Piping.

F. Section 22 40 10 - Plumbing Specialties.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 23 00 00.

B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - FIXTURES

A. American Standard, Kohler, Elkay, Crane . Substitutions: Under provisions of Section 23 00 00.

2.02 ACCEPTABLE MANUFACTURERS - FIXTURE TRIM

A. American Standard, Elkay, Chicago Faucet, Delta. Substitutions: Under provisions of Section 23 00 00.

2.03 ACCEPTABLE MANUFACTURERS - FLUSH VALVES

A. Sloan, Zurn. Substitutions: Under provisions of Section 23 00 00.

2.04 ACCEPTABLE MANUFACTURERS - WATER CLOSET SEATS

A. Olsonite, Bemis, Centoco. Substitutions: Under provisions of Section 23 00 00.

2.05 ACCEPTABLE MANUFACTURERS - FIXTURE CARRIERS

A. Wade, Zurn. Substitutions: Under provisions of Section 23 00 00.

2.06 ACCEPTABLE MANUFACTURERS - ELECTRIC WATER COOLERS

A. Elkay. Substitutions: Under provisions of Section 23 00 00.

PART 3 - EXECUTION

3.01 INSPECTION

A. Review millwork shop drawings. Confirm location (from architectural dimensional drawings) and size of fixtures and openings before rough-in and installation.

B. Verify adjacent construction is ready to receive rough-in work of this Section.

3.02 INSTALLATION

A. Install each fixture level and plumb with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops reducers and chrome plated 17 gauge brass P-trap with escutcheons.

C. Install fixtures and valves at elevations to meet requirements of plumbing code and handicap code (ADA).

3.03 ADJUSTING AND CLEANING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. At completion clean plumbing fixtures and equipment.

C. Solidly attach water closets to floor.

3.04 FIXTURE ROUGH-IN SCHEDULE

A. Rough-in fixture piping connections in accordance with following table of minimum sizes for particular fixtures.

	Hot Water	Cold Water	Waste	Vent
Lavatory	1/2 inch	1/2 inch	1-1/2 inch	1-1/4 inch
Service Sink	1/2 inch	1/2 inch	2 inch	1-1/2 inch
Sink	1/2 inch	1/2 inch	1-1/2 inch	1-1/4 inch
Elec. Water Cooler	--------	1/2 inch	1-1/4 inch	1-1/4 inch
Water Closet (Flush Valve)	--------	1 inch	3 inch	2 inch
Urinal (Flush Valve)	--------	3/4 inch	2 inch	1-1/2 inch

END OF SECTION 22 41 00 – PLUMBING FIXTURES

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SECTION 23 00 00

MECHANICAL GENERAL PROVISION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Division includes all labor, materials, equipment, tools, supervision, start-up services, Owner's Instructions, including all incidental and related items necessary to complete installation and successfully test and start up and operate in a practical and efficient manner the Mechanical Systems indicated on Drawings and described in each Section of Division 23 Specifications and conforming with all Contract Documents.

B. Bidding: the Contractor shall bid the project in strict accordance with the plans and Specifications. Alternative methods or materials, beyond those indicated as "Base Bid", proposed by the Contractor shall be in the form of a voluntary alternate, with all details indicated, and a separate add or deduct price for these changes submitted with the Contractor's bid. (Reference General Requirements – Product Substitutions)

C. Mechanical systems complete and in place, shall include the following:

MECHANICAL:

SECTION 23 00 00	MECHANICAL GENERAL PROVISIONS
SECTION 23 05 00	BASIC MECHANICAL MATERIALS AND METHODS
SECTION 23 0 516	EXPANSION COMPENSATION
SECTION 23 05 23	VALVES
SECTION 23 05 29	SUPPORTS AND ANCHORS
SECTION 23 05 48	VIBRATION ISOLATION
SECTION 23 05 53	MECHANICAL IDENTIFICATION
SECTION 23 05 93	TESTING, ADJUSTING AND BALANCING
SECTION 23 05 94	AQ FOR OCCUPIED BUILDINGS UNDER CONSTRUCTION
SECTION 23 07 00	THERMAL INSULATION
SECTION 23 21 13	HYDRONIC PIPING
SECTION 23 25 00	CHEMICAL (WATER) TREATMENT
SECTION 23 31 00	DUCTING
SECTION 23 41 00	AIR FILTERS
SECTION 23 52 16	PACKAGED BOILER
SECTION 23 83 16	RADIANT-HEATING HYDRONIC PIPING

FIRE SUPPRESSION:

SECTION 21 13 00	WET/DRY PIPE FIRE SUPPRESSION SYSTEM

PLUMBING:

SECTION 22 11 16	PLUMBING PIPING
SECTION 22 40 10	PLUMBING SPECIALTIES
SECTION 22 41 00	PLUMBING FIXTURES
SECTION 22 30 00	PLUMBING EQUIPMENT

CONTROLS:

SECTION 25 00 00	BUILDING CONTROL SYSTEM
SECTION 25 51 00	SEQUENCE OF OPERATION

D. The General Provisions of this Contract, including General and Supplementary Conditions and other General requirements Sections, apply to the Work specified in this Section.

E. This Section is not intended to supersede, but to clarify the definitions in Division 1, General Requirements and Supplementary Conditions.

F. Drawings and Specifications:

1. Drawings and Specifications are intended to complement each other, and all work specified and not shown or work shown and not specified shall be provided as though mentioned in both specifications and drawings.

2. Minor items and accessories or devices reasonably inferable as necessary to the complete and proper operation of any system shall be provided by the Contractor or Subcontractor for such system, whether or not they are specifically called for by the specifications or drawings.

3. Drawings are diagrammatic and indicate general arrangement of systems and work included in the Contract, and shall serve only as design drawings, to represent design intent for general layout of various equipment and systems and not intended to be scaled for rough-in measurements or to service as measured shop drawings.

4. If directed by the Engineer, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work. (Refer to General Requirements for co-ordination between trades).

1.02 RELATED WORK

A. Section 26 00 00 - Electrical General Provisions

B. All building construction documents.

1.03 COORDINATION OF WORK

A. Responsibility:

1. The Mechanical Contractor shall be responsible for his Sub-Contractors and Suppliers, and include in his bid all materials, labor, and equipment involved, and install in accordance with all local customs, codes, rules, regulations, jurisdictional awards, and decisions; and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.

2. The Mechanical Contractor and Sub-Contractor shall be responsible for all tasks applicable to their trades as directed by the General Contractor, in accordance with the Specifications, Drawings, and code requirements, and shall be responsible for coordinating locations and arrangements of their work to give best results with all other relevant Mechanical, Architectural, Structural and Electrical Contractors' Specifications, Drawings and shop drawings. Coordinate work so that sprinkler heads, lights, diffusers, etc. are coordinated into Project and are installed per the architectural reflected ceiling plan.

B. Site and Project Document Examination:

1. Submission of a proposal is considered evidence that the Contractor has visited site and acquainted themselves with all existing conditions, made all necessary measurements, examined the Drawings and Specifications of all trades, including Mechanical, Architectural, Structural, and Electrical, and has fully informed himself with all Project and site conditions, and is proficient, experienced and knowledgeable of all standards, codes, ordinances, permits and regulations which affect the installation of his respective trade, and that all costs are included in his proposal.

2. No allowance shall subsequently be made in his behalf for extra expense incurred due to failure or neglect on his part to make this visit and examination.

3. The Mechanical Contractor and/or Sub-Contractor shall obtain all required permits and assessments have been obtained prior to starting work. Contractor shall verify requirement to include privilege fees and permits as part of his formal bid, as described in General and Supplementary Conditions.

4. It is the responsibility of the Contractor to notify the Engineer, prior to submitting his bid, of any potential problems that he has identified during his site visit or from examination of the Contract documents.

C. General Supports:

1. Provide all necessary angle and channel brackets or supplementary steel as required for adequate support for all piping, specialties, and equipment which is hung or mounted above floor. No trade shall hang equipment from work of another trade (such as sprinkler lines hanging from heating lines or electrical conduit). Secure approval from Architect, in writing, before welding or bolting to steel framing or anchoring to concrete structure.

2. Where piping or equipment is suspended from concrete construction, set approved concrete inserts in formwork to receive hanger rods, such as Unistrut or Powerstrut, and where installed in metal deck, use Ramset or Welds as required.

D. Access Panels:

1. No valve, trap, control, fire damper, duct access opening, etc., shall be installed in inaccessible locations without access panels. Any subcontractor having items requiring access shall also include access panels for same unless Drawings indicate otherwise. Contractor shall be responsible for quantities of panels and receive approval for locations of panels from Architect/Engineer before installation.

2. Any wall, ceiling, or floor access panels required shall be equal to Milcor with hinged door and latch. Those in walls or floor shall be type to accept finished surface material. Those in ceiling shall be exposed metal.

3. Removable ceilings or sections of ceilings are acceptable as access panels. Panels in rated construction shall have U.L. label and proper rating and construction to match partition, ceiling, or roof assemblies in which they occur.

4. Purchase proper access panel, coordinate location, have General Contractor install access panel, and reimburse for installation. This trade is to coordinate the access panel manufacturer with the architectural access panels.

E. Field Changes:

1. This Contractor shall not make any field changes which affect timing, costs, or performance without written approval from the Architect/Engineer in the form of a Change Order, Field Change Order, or a Supplemental Instruction. In special circumstances, verbal approvals pending paperwork may be acceptable. The Contractor assumes liability for any additional costs for changes made without such instruction or approval. Should any unauthorized change be determined by the Architect/Engineer as lessening the value of the project, a credit will be determined and issued as a change to the contract in accordance with the General Requirements.

1.04 STANDARDS, CODE AND PERMITS

A. Refer to General Requirements and Supplementary Conditions.

B. All work installed under Mechanical Sections shall comply with latest edition of applicable standards and codes of following:

ADAG	Americans with Disability Act Guidelines, Title III
ASA	American Standards Association
ASME	American Society of Mechanical Engineers
SMACNA	Sheet Metal & Air Conditioning Contractor Association
NSF	National Sanitation Foundation
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM	American Society of Testing Materials
ANSI	American National Standards Institute
AGA	American Gas Association
AWWA	American Water Works Association
NFPA	National Fire Protection Association
IBR	Institute of Boiler and Radiator Manufacturers
AWS	American Welding Society
UL	Underwriter's Laboratories
NEMA	National Electric Manufactures Association
NESC	National Electric Safety Code (H13)
ARI	American Refrigeration Association
OSHA	Occupational Safety and Health Act
ABMA	American Boiler Manufacturers Association
BOCA	Mechanical and Plumbing Code as Amended by State of Michigan
CAGI	Compressed Air and Gas Institute

C. All work shall be provided and tested in accordance with all applicable local, county, and state laws, ordinances, codes, rules, and regulations.

D. Contractor shall give all notices, file all drawings, obtain necessary approvals, obtain all permits, pay all fees, deposits, and expenses required for installation of all work under this Contract.

E. No work shall be covered or enclosed until work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by Contractor and kept on file for inspection by the Engineer.

F. In general, all material, where applicable, shall be labeled or listed by Underwriters' Laboratories, Inc.

G. In the event that plans and specifications conflict with any rules, regulations, or codes applying, said rules, regulations, and codes shall govern the Contractor.
H. Michigan Mechanical Code latest required version.

1.05 SUBMITTALS

A. Shop Drawings:

1. After a schedule of Sub-Contractors is approved by the Engineer, submit six (6) neatly bound copies of shop drawings (or number as directed by General Requirements) with one device or fixture of each type clearly identified (high-lighted, bolded, underlined, etc.) in each set on equipment and materials indicated on drawings or in the specifications.

2. Submit complete manufacturer's shop drawings of all equipment, plumbing fixtures, accessories, and controls, including dimensions, weights, capacities, construction details, installation, control methods, wiring diagrams, motor data, etc.

3. Engineer's approval of shop drawings is for general application only, and is a service that is not considered as a guarantee of total compliance with, or that relieves the Contractor of basic responsibilities under all Contract Documents, and does not approve changes in time or cost.

4. After approval, each Contractor is responsible for expeditiously providing information to all other trades involved in, or affected by, installation of his equipment and work.

B. Operating and Maintenance Instructions and Manuals:

1. Each Contractor shall provide for all major items of equipment two (2) copies, in 3-ring notebooks, of indexed sets of operating and maintenance instructions to Engineer for approval. After approval, manuals will be given to Owner by Engineer.

2. Manuals shall include a complete set of shop drawings submitted, repair parts lists, manufacturer's standard equipment manuals, valve tag schedule, and automatic control diagrams, all indexed with tabs for each section.

   a. Operating Instructions:
   Typewritten instructions regarding the starting and operating of all equipment and accessories. Operating instructions shall be encased in plastic and mounted in mechanical room. Provide additional copies of above materials in 3-ring notebooks. Operating instructions within notebooks shall also include locations of temperature control devices, switches, and equipment (including air handlers, pumps, etc.). Also, include steps of trouble-shooting and describe areas served by equipment.

   b. Maintenance Instructions:
   Provide a list of all mechanical contractors and subcontractors, including contact person and day/night telephone numbers. Upon completion of work, provide for periods not less than four (4) hours, competent person to instruct Owner in operation and maintenance of mechanical systems, equipment, controls, etc.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standards:

1. All products shall be provided by established manufacturers regularly engaged in making the type of materials to be provided and shall be complete with all parts, accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

B. Substitution and Changes:

1. Contractor and/or Equipment Supplier may propose alternate equipment or materials of equal quality, function, durability, and appearance as described and permitted in Specification Section 25 00 00, 1.01.B. The substitution will take the form of an "Add-Deduct" at the time of bid submittal. It is the submitter's responsibility to provide sufficient material for review as may be required by the Engineer's office. Acceptance and approval is the responsibility of the Engineer.

2. No substitutions will be accepted, except as authorized in a Project Addendum.

3. Contractor and/or Equipment Supplier is liable for any added costs to himself or others, and is responsible for verifying dimensions, clearance, and roughing-in requirements, when product not specifically named or described as the basis of design is used. The Contractor is responsible for advising other Contractors of variations and, if requested, submitting revised drawing layout for approval of the Engineer.

C. Explanation of Scheduled Manufacturers:

1. **Base Bid**. This term designates that this equipment will be the product which the contractor generates his bid from. It is usually a component that is critical to maintaining the design intent. No other equipment suppliers will be allowed to bid as an equal.

2. **Based On**. This term designates that the equipment is designed around a certain product. Products of equal status are listed and may be bid as if they were the basis of design. The **based on** equipment shall serve as the standard to which equals will be judged.

2.02 ELECTRICAL REQUIREMENTS

A. Motor Starters and Controls:

1. Electrical Contractor shall provide all manual or magnetic motor starters as required for motors as indicated on the Electrical Drawings and specified in Division 26.

2. Mechanical Contractor shall provide factory installed motor starters and/or safety switches, integral with packaged equipment, containing thermal over current protection in ungrounded conductors with heater coils selected for specific motor usage for motors.

3. "Package equipment" shall be defined as Mechanical, Architectural, Civil, or other Trade's equipment, and which is specified in other divisions of this specification, and which shall be furnished and installed complete with all associated electrical components by those trades.

   Other Trades providing package equipment shall also provide both integral and remotely located devices if necessary for a complete system, ready for operation except for a single incoming power source. These devices may include main disconnect switches, heavy duty disconnect switches, starters, control transformers, interlocks, relays, fuses, terminal blocks, capacitors, wire, wire and devise identification, conduit, and other necessary components.

   Any special work to be provided under this division of the specifications outside the definition of package equipment shall be as noted on the drawings accompanying these specifications, or as specially noted after the package equipment list entry hereinafter.

B. Electrical Wiring and Controls:

1. Mechanical Contractor shall provide all motors, drives, and controllers integral to packaged equipment and factory mounted controls for all mechanical equipment. When pre-wired equipment is used, control circuit shall be separately fused at control transformer, and shall always revert to a fail-safe condition.

2. Mechanical Contractor shall provide electrical devices requiring mechanical/electrical connections, such as pressure switches, limit switches, float switches, solenoid valves, motor operated valves, etc.

3. Electrical Contractor shall install power wiring and conduit to motors and/or factory mounted control panels as indicated on Drawings or in specifications.

4. All electrical wiring work by Mechanical Contractor shall be in accordance with Division 16 requirements.

PART 3 - EXECUTION

3.01 CONNECTIONS AND SERVICES

A. Connections to Existing Lines Within Building:

1. Where existing lines are indicated on Drawings, connection shall be on an "as found" basis. Include all necessary costs to make proper connection.

2. Locate, identify, maintain, and protect existing mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Connecting Into Existing Facility and Street Lines:

1. Connection into existing service and street lines shall be on an "as found" basis. All service interruption shall be coordinated with Owner and public utility. No interruption of utilities shall be made without prior arrangement with Owner.

2. Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.

C. Continuity of Services:

Continuity of all existing utility services in building shall be maintained throughout construction period. Where new services are to be tied into existing services, it shall be done when and as directed by Owner, General Contractor, or Engineer.

3.02 CLOSEOUT

A. Final Acceptance:

Final acceptance and payment will only be made after the final check list completion and receipt at Engineer's office of:

All Guarantees/Warranties
Test Reports
Operating and Maintenance Instruction Manuals (2)
Record Drawings (As-Built)
Certificates of Inspection
Lubrication and Valve Charts
Maintenance Contracts, if required
Spare Parts (i.e. filters, etc.)
Test and Balance Reports - Air and Hydronic
Boiler Start-up Report

B. Certificates of Inspection and Test Reports:

The Contractor is to provide the Engineer with evidence that the installation has been inspected and approved by municipal or state inspector having jurisdiction over that phase of work involved, i.e., plumbing, heating, boiler, fire protection, refrigeration, etc.

C. Guarantees and Warranties:

1. During the one year guarantee period (except if General Requirements specify a longer warranty period), make two complete inspections (at approximately 3 months and 10 months) of all systems, fixtures, equipment, safety devices, and controls to ensure that the equipment is operating properly, and report to the Engineer in writing. The visits are to be coordinated with the owner.

D. Record Drawings:

1. Maintain a white-print set of Mechanical Contract Drawings in clean, undamaged condition for mark-up of actual installation on Contract Drawings, which vary substantially (i.e. location of piping, ductwork, size changes, etc.) from the work as shown.

E. Operating and Maintenance Instructions:

1. Provide instruction of Owner's personnel in operation and maintenance procedures for all systems equipment such as boilers, HVAC equipment, temperature controls, etc.
2. Provide the Owner with instructions on the location of hand valves, and other concealed items, etc.

F. Placing Systems into Operation:

1. Mechanical Contractor shall be responsible for all start-up procedures, system checks and balancing, and coordinating work of other Contractors and Sub-Contractors to assure cooperation.

2. All equipment shall be installed, tested and operated in accordance with the manufacturer's recommendations at normal operating conditions.

3. Permanent equipment may be operated during construction only with adequate protection from damage and dirt by filtering of air using minimum 30% efficient filters or straining of fluids, and replacing as often as necessary to keep mechanical systems reasonably clean and dust free and replacement at turnover to owner.

4. Place all systems into operation, when weather or other considerations require their use. Perform repair, adjustment and balancing operations as often as required to assure satisfactory operation before final acceptance.

5. Check, test and adjust pressure reducing and relief valves, thermometers, gauges, meters, safety controls and devices, and other instruments and controls to assure proper operation.
6. Tests:

   a. Make necessary tests to provide leak-proof and code-tested system under operation. Make tests before work is concealed or covered and perform all necessary repairs as required or as otherwise indicated by test results.

   b. See subsequent trade sections for additional requirements.

   c. Soil, waste, and vent piping shall be closed and tested with water at head equal to highest fixture.

   d. Domestic hot and cold water piping and all heating lines shall be tested at 125 PSI. Gas piping shall be tested at 125 PSI with soap bubbles.

G. Adjustments and Balancing:

1. Subsequent to the installation of the heating, piping, and air distribution systems and upon the beginning of operation, the Contractor shall make all necessary adjustments to equipment, control dampers, fans, and any other equipment installed by him under this Contract so as to ensure proper operation of the same. The Contractor shall be responsible for balancing the air system to deliver the air quantities shown on the Plans. This shall include changing fan speeds, belts, drive, sheaves, and drive guards as required to properly balance these systems. The Contractor shall be responsible for balancing the hydronic system to deliver the flow required to service each device as shown on the plans. This shall include changing impellers, pumps, auto flow control valves and circuit setters, as required to properly balance these systems. The Contractor shall have an independent AABC or NEBB subcontractor submit (2) copies of his balancing work sheets indicating preliminary and final results. All balancing shall be performed as specified in the SMACNA Manual and ADC Standards. **Balancing must be completed and report submitted before Engineer completes final check list.**

3.03 GUARANTEES AND WARRANTIES

A. All labor, materials and equipment shall be guaranteed by Contractor and/or warranted by the Manufacturer for one year after acceptance date and/or one normal continuous complete season's operation applicable to equipment or system except where specified longer for special equipment. Contractor shall secure such warranty from all Suppliers or the Contractor will assume the warranty and issue an Insurance Policy to the owner.

B. Acceptance date of substantial completion shall be Owner occupancy as determined by Architect/Engineer.

C. Contractor shall make all necessary alterations, repairs, adjustments, and replacements during guarantee periods as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner. The Contractor shall repeat as often as necessary to give satisfactory system in opinion of Engineer.

D. Repair or replacements made under guarantee shall bear further one year guarantee from date of acceptance of repair or replacement.

3.04 COMMISSIONING SERVICES

A. All services and requirements of the commissioning agent (CA) shall be completed in a timely manor.

B. All reports, training, and TAB services shall be completed as required in construction documents.

END OF SECTION 23 00 00
MECHANICAL GENERAL PROVISIONS

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SECTION 23 05 00

BASIC MECHANICAL MATERIALS & METHODS

PART 1 - GENERAL

This Specification is intended to describe general mechanical systems' methods and materials.

1.01 RELATED WORK

A. Section 23 00 00 - Mechanical General Provisions
B. Section 26 00 00 - Electrical General Provisions

1.02 WORKMANSHIP

A. Install work in accordance with best practice of trade.

1. Install new piping and ductwork straight and true with no unnecessary offsets and parallel with walls, beams, floors, or ceilings.

2. Install new piping so as to be completely drainable. Provide drain cocks and capped hose adapters at all low points in piping system.

3. Provide for expansion and contraction of piping at bends or risers. Install piping so as to be free from pockets due to sagging.

4. Where no elevation is indicated, piping and ducts suspended above and/or below ceilings shall be hung as high as possible.

5. No piping shall be installed in a manner which will interfere with necessary passage or head room, with operation of any doors or windows, with ductwork, lay-in ceiling panels, lighting outlets or fixtures, or Owner's equipment.

6. No piping over electrical equipment, elevator machine rooms, electrical rooms, and telephone rooms without prior approval from Architect/Engineer.

1.03 PIPES AND PIPE FITTINGS

A. General:

1. Coordinate with work of other trades. Piping shall not be supported from ductwork or piping of other trades.

2. Support piping from structure using approved hangers; pipe straps shall not be permitted.

3. Allow for adequate expansion and contraction while maintaining alignment. Provide expansion joints or loops as required.

4. Use reducing fittings when changing pipe sizes. Bushings and "Orange Peeling" shall not be permitted.

5. Terminate piping to fixtures and equipment furnished by others including stop valves.

6. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.

7. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.

8. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged) which effectively isolate dissimilar metals, to prevent galvanic action, and stop corrosion.

9. Install flanges in piping 2-1/2" and larger, adjacent to each valve, at the final connection to each piece of equipment, and elsewhere as indicated.

10. Install sectionalizing valves at main branch lines where branch connects into mains.

11. Fit all openings in piping with temporary plugs and caps during construction.

12. Insulating couplings shall be installed at all locations where copper piping connects to other metals and in gas piping at meter connections.

13. If leak occurs, pipe or fitting shall be replaced with new length or fitting. Ream out all pipe ends. Clean out debris and excess oil before installing. Use approved lubricant for all threaded joints. Do not stop leaks by adding caulking to joints.

14. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade of floors, unless indicated otherwise.

15. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

16. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained. Refer to Architectural Drawings or Plans indicating walls, floors, or ceilings requiring ratings and the amount of rating.

17. Drip Pans: Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2" with reinforced top. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.

18. Drip Pan Installation: Locate drip pans under piping, passing over or within 3" horizontally of electrical equipment, under roof relief vents, and elsewhere as indicated. Hang from structure with rods and building attachments, attach rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

B. Sleeves and Escutcheons:

1. Piping passing through concrete and masonry walls and floors shall be sleeved; wall sleeves shall be cut back 3/8" from face of wall.

2. Sleeves shall be fabricated from sections of steel pipe, 1/2" to 1" larger than pipe or insulation.

3. Sleeves passing through floors shall extend 3/8" above floor. Void between sleeve and pipe shall be caulked water tight. Use fire-rated sealants at rated floors and walls.

4. Sleeves shall be permanently mortared in.

5. Where pipes pass through exterior walls, seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal. Pipe to be sealed with 100% Silicone caulking to create an air tight seal.

6. Wherever pipes are exposed and pass through walls, floors, partitions, or ceilings, they shall be fitted with chromium plated escutcheons, held in place by internal spring tension. Escutcheons shall be large enough to fit over insulation on insulated pipes.

7. Plumbing vent stacks passing through roofs shall have a vent collar/seal installed.

C. Pipe Joints:

1. Steel Pipe Joints:

a. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is to be used.

b. Pipe Larger than 2": Weld pipe joints for steel pipe (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.

2. Brazed and Solder Joints: For copper tube and fitting, braze joints in accordance with ANSI B31.1.0 - Standard Code for:

a. Pressure Piping, Power Piping; ANSI B9.1 - *Standard Code for Mechanical Refrigeration.*

b. Solder: Type of solder shall conform to following schedule:

- Hot and cold water and recirculating lines - lead free solder.
- Heating piping – lead free solder.
- Drain piping – lead free material if possible.
- Condensate drain piping – lead free solder
- Refrigerant hot gas and liquid lines - silver braze.
- Refrigerant suction lines - silver braze.
- Refrigerant line connections to equipment – lead free solder.

3. Welding:

a. Qualifications: Welders shall be qualified according to provisions of *ASME Standard Qualifications for Welding Procedures, Welders and Welding Operators, or ASME Boiler and Pressure Vessel Code* for class of piping being welded. Submit welding qualifications for all welders on project when requested by Engineer.

b. Welding Procedure: Preparation of base metals and welding procedures shall conform to ASME American Standard Code for Pressure Piping.

c. Filler Material: Conform to ASTM Specifications compatible with base metal being welded.

d. Field Fabricated Fittings: Mitered or segmental elbows, swages, orange-peel, bull plugs, or similar construction will not be permitted.

e. Branch Connections: Welding of branch connections directly to run will be permitted in lieu of tees, laterals, or crosses when branch sizes are less than 1/2 of main size unless detailed otherwise. Branch pipe shall not project beyond inside of main. Failure to comply with accepted standards of workmanship in making weld-in branch lines shall require that these connections be removed and replaced with ASA B 16.9 fittings.

4. Caulked Joints:

a. Provide thick ring of oakum tightly into hub of pipe, pour hub full of non-lead material and caulk. Connections between steel and cast iron pipe shall be caulked with oakum and non-lead material.

b. Tyler "XH" extra heavy TY-Seal Gaskets may be used in lieu of caulked joints for buried cast iron pipe.

5. Mechanical Joints or Shove-On Joints: Follow manufacturer's recommendations for joint assembly. Provide socket clamps with tie rods at all dead ends, run outs, direction changes, and similar locations where other means of anchoring are not provided.

D. Pipe:

1. Steel Pipe:

a. Highest quality, mild steel.

b. Manufacturer's name shall be stamped or rolled into each length of pipe.

2. Black Steel Pipe:

a. Pipe: Schedule 40, ASTM-A-120.
Use: Above ground gas piping.

b. Screwed Fittings:
Use: 2" and under accessible locations.

i. Type: 150# malleable iron-banded.

ii. Unions: Ground bronze to iron seat with extra heavy body and nuts.

iii. Nipples: Same as pipe, except use Schedule 80 for short and close nipples.

c. Welded Fittings:

Use: Over 2" and non-accessible locations.

i. Type: 150# W.P. - conforming to ASTM A234 Grade WAPB, and U.S.A.S. B 16.9 butt weld.

ii. Elbows: Long radius, butt weld.

iii. Unions: Companion flanges, 150# raised face, slip-on conforming to U.S.A.S. and ASTM specifications; use welding neck flanges at pump connections. Flanges shall have American Standard Template drilling.

3. Galvanized Pipe: Schedule 40, ASTM A-120. Screwed fittings for waste, drain, and vent piping.

E. Sanitary Pipe and Storm Water Pipe and Fittings:

1. ABS Pipe:

a. Sanitary Sewer and Storm Water Piping, Buried Beyond 5 Feet of Building: ABS pipe: Schedule 40 ASTM F 628 or ASTM D 2282 – 99(2005). Fittings: ABS.

b. Sanitary Sewer and Storm Water Piping Above Grade (In Exposed Areas): ABS pipe: If used in exposed areas, piping must be covered with minimum 1" fiberglass insulation with approved fire resistance rating. **NOTE:** Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling inside a building. Not approved for vertical runs in interior walls.

2. PVC Pipe:

a. Sanitary Sewer and Storm Water Piping, Buried Beyond 5 Feet of Building: PVC pipe: ASTM D3033 or D3034, SDR 35. Fittings: PVC. Joints: ASTM F477, elastomeric gaskets.

b. Sanitary Sewer and Storm Water Piping, Buried and Above Grade, but Concealed Within Building: PVC pipe: ASTM D2665, D3034. Fittings: PVC. Joints: ASTM D2855, solvent weld. **NOTE:** Concealed is defined as a pipe that is contained within a wall or in a fire rated chase.

c. Sanitary Sewer and Storm Water Piping Above Grade (In Exposed Areas): PVC pipe: ASTM D2665, D3034. Fittings: PVC. Joints: ASTM D2855, solvent weld. If used in exposed areas, piping must be covered with minimum 1" fiberglass insulation with approved fire resistance rating. **NOTE:** Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling inside a building.

d. Not approved for vertical runs in interior walls.

3. Cast Iron Pipe:

a. Sanitary Sewer and Storm Water Piping Above Grade **(In Exposed Areas)**: Cast iron ASTM A74; C1SP1 301. Fittings: ASME B16.4; ASME B16.12. **NOTE:** Exposed is defined as a pipe that is exposed to view or installed above an accessible ceiling.

b. **All vertical runs of Sanitary Sewer and Storm Water are to be run in Cast Iron.**

4. **Chrome Plated Drain Lines:** Use chrome plated drain lines for all exposed piping under sinks, etc.

F. Copper Pipe and Fitting (Domestic Water - Above Ground/Underslab & Heating):

1. **Pipe:** Conform to ASTM Specifications. Pipe shall be color coded or marked at factory for identification. Tubing shall conform to following:

a. Above Ground: Type L hard drawn, ASTM B-88.

b. Buried: Type K, annealed temper, ASTM B-88.

c. Refrigeration: Type ACT, hard drawn, ASTM B-280.

d. Drainage: Type DWV, ASTM B-306.

e. Exposed: Use chrome plated piping for all exposed domestic water piping for sinks, toilets, urinals, etc.

2. **Fittings:**

a. General Service: Sweat type, wrought copper (cast fittings permitted only where wrought copper is not manufactured). Long radius elbows.

b. Drainage: Sweat type, wrought copper, drainage pattern. Specialty items such as closet elbows may be cast brass.

G. Plastic Pipe and Fittings (Domestic Water - Underslab):

a. Pipe: Schedule 80 ABS - conform to ASTM D2282-99(2005) and MIL-STD-129, 160 psi working pressure.

b. Fittings: ABS

H. Grooved Piping:

1. **Pipe:** Schedule 10 ASTM A-120 with factory supplied roll grooves that meet grooved coupling manufacturer=s latest specification. All field roll grooves must be measured with a pi-tape and meet specification prior to coupling assembly. **Note:** This assembly method is important and joints will be randomly field checked by the engineer.

2. **Gaskets:** Gaskets must be Grade E with a Flushseal center leg design as provided by Victaulic Company of America or engineer approved equal. All product submittals must be approved prior to bidding. All gaskets must be lubricated with a non-petroleum based lubricant compatible with the grooved coupling manufacturer=s gasket. Approved grooved coupling manufacturers: **Victaulic only**.

3. **Fittings:** All grooved fittings must be domestic and of one manufacturer. All grooved fittings must be manufactured of ASTM A-536 Ductile Iron. Approved grooved fittings manufacturers are **Victaulic Company of America**.

4. **Couplings:** All grooved couplings must be domestic and of one manufacturer. All couplings shall be Zero-Flex Arigid@ design. All couplings must be installed as per the manufacturer=s latest recommendations. Provide all necessary anchors, supports and restraints per the manufacturer=s recommendations for all grooved pipe systems. Three (3) flexible grooved Style 77 or 75 couplings may be used at all pumps in lieu of flex connectors.

5. **Grooved Valves:**

   a. All grooved butterfly and check valves must be of one domestic manufacturer and shall be rated to 300 PSI. All grooved valves shall have an internal and external PPS coating and the disc liner must be consistent with that of the grooved coupling gasket and be compatible for the service. All grooved butterfly valves must have a blowout proof stem. The disc and stem must be of a one piece ductile iron construction.

   b. Butterfly Valves 2" - 6" must have a 10 position lever lock handle and valves above 6" must have a gear operator.

   c. Tour & Anderson circuit balancing valves series 787 threaded, series 786 solder end & 789 grooved end arc are approved for heating services.

6. **Straining Devices:** Victaulic S/730 Tee strainer & 731 Suction Diffuser are approved for heating services.

1.04 VALVES

A. All valves shall be of same manufacturer.

B. Where grooved piping system is specified, groove end butterfly valves equal to **Victaulic**.

C. Valves are rated for 125 PSI service. Provide higher rated (250) PSI valves per system requirements.

D. Valves shall be submitted with shop drawings for various uses.

E. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

F. Install globe valves for throttling, bypass, or manual flow control services.

G. Provide spring loaded check valves on discharge of water pumps.

1.05 PIPING SPECIALTIES

A. General: All piping systems shall be complete with all specialties and appurtenances required for complete operating system.

B. Expansion Loop Guides: Two installed on each side of loops, securely anchored to building structure.

C. Expansion Joints: Iron body, internal guides, stainless steel bellows. Piping shall be properly guided at all expansion joints and at intermediate locations as recommended by manufacturer.

D. Mechanical Type Couplings: Victaulic.

E. Insulating Couplings: Install at all locations where copper tubing connects to galvanized iron pipe and gas piping at meter connections.

F. Strainers and Filters:

1. Strainers: Strainers shall be Y pattern, 125# W.P. iron body for general use and 250 p.s.i. WSP for high pressure process and hydraulic use.

a. Screwed: For piping 2" and smaller.

b. Flanged or Grooved: For piping 2-1/2" and larger.

c. Screens: Monel, cylindrical, reinforced ends. 20 mesh for water; 40 mesh for air, gas.

G. Vacuum Breakers and Backflow Preventers

1. General: Vacuum breakers and backflow preventers shall be installed in accordance with all applicable codes and as specified.

2. Vacuum Breakers:

a. Domestic Service: Vacuum breakers shall be provided on all flush valves, hose faucets, laboratory sinks, chemical vats, laundries, swimming pools, process equipment, fittings, and fixtures covered by codes. Vacuum breakers shall be chrome plated where located exposed in finished portions of building.

b. Installation: Vacuum breakers shall be installed above highest fixture they are protecting in such manner that it will preclude back pressure. Vacuum breakers shall be installed where they will be accessible for periodic testing and where spillage will not be objectionable.

3. Backflow Preventers:

a. General: Backflow preventers shall be installed in all systems where domestic water is subject to contamination due to reduced pressures causing backflow such as heating and cooling system make-up water, lawn sprinklers, and all areas designated by local codes as health hazard. Backflow preventers may serve more than one piece of equipment or system as long as cross contamination between systems is not objectionable. Backflow preventers shall be of reduced pressure, dual, spring loaded, check; intermediate vacuum breaker.

b. Installation: Backflow preventers shall be installed in horizontal position in open accessible for maintenance and periodic inspections and testing. Backflow preventers shall be piped with drain line to nearest floor drain. Drain shall terminate at floor drain with minimum of 12" air gap and in area not subject to flooding or freezing.

c. Drain Pan: Install galvanized drain pan under all backflow preventers installed above ceilings, pipe 3/4" copper line from drain pan to nearest floor drain or mop sink. Pan shall be 3" wider and longer than backflow preventer size. Depth of drain pan shall be 1-1/2".

1.06 GAUGES AND THERMOMETERS

A. Gauges: Provide 4-1/2" face glass, aluminum body pressure gauges with adjustable pointer, gauge cocks, and shock reducing snubber. Each gauge shall be labeled to indicate units in "PSI" or "FT-HD" on gauge face. Gauge pressure shall be selected to give approximately two (2) times pressure that gauge will encounter constantly. (Example: 15 PSI steam gauge range 0 to 30 PSI.) Install at following locations or as indicated on prints.

1. All heating pumps' inlets and outlets.

2. All domestic hot water pumps' inlets and outlets.

3. Cold water supply at meter outlet or connecting point where cold water supply for new addition connects to old line (if in exposed location).

4. Water meter inlet and outlet.

B. Thermometers: Thermometers shall be installed on water side and set so that they do not restrict or obstruct fluid flow. Install at following locations or as indicated on prints.

1. At each heating return line balancing valve that occurs in return main where two or more heat users return water to it.

2. At all three ports of 3-way valves.

3. At domestic hot water tank supply and return pipes, near pump.

4. At inlet and outlet of hot water heating coils.

5. At boiler inlet and outlet.

1.07 DUCTWORK

A. General:

1. Before proceeding with fabrication and installation of ductwork, inspect the contract documents, site conditions and truss shop drawings and determine that the location of work does not interfere with other work. In case of interference, notify the Engineer.

2. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

3. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

4. Connect diffusers or troffer boots to low pressure ducts with 5 feet maximum length of flexible duct only in accessible areas where a ceiling is installed. Hold in place with strap or clamp.

5. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

6. Where ductwork, structure, etc. can be seen behind grilles, registers, diffusers, etc. apply flat black paint to all visual surfaces.

B. Ductwork:

1. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.

2. Steel Rectangular Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per square feet for each side in conformance with ASTM A90.

3. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.

4. Round Spiral Ducts: ASTM A-527-71, galvanized steel, spiral locking seam equal to United McGill Uni-Seal. For underslab ductwork, use United McGill Uni-Coat.

5. Internal Insulated Round Spiral Ducts: ASTM A-527-71, galvanized steel, spiral locking seam equal to United McGill Uni-Rib k-27.

6. Stainless Steel Ducts: ASTM A167, type 304.

1.08 SUPPORTS AND ANCHORS

A. General: Furnish and install all necessary pipe hangers, rollers, and duct hangers required for all systems. Hanger rod shall be all-thread carbon steel type. Rod shall conform to ASA B1/1960 Class 2A fit.

B. Ductwork: Supports and hangers for ductwork and appurtenances shall conform to *Manual of Sheet Metal and Air Conditioning Contractors Association, Inc. and latest edition of American Society of Heating, Refrigeration, and Air Conditioning Engineers Handbook* Ducts 36" x 12", or equivalent, and larger, shall be supported by trapeze type hangers.

C. Pipe Hangers: First two piping supports away from new mechanical equipment supporting 1" diameter pipe or larger shall be isolated from structure by means of vibration and noise isolators. This piping shall be isolated with Type "H" Hangers. Floor mounted piping shall be isolated with Type "S" Spring Mounts for first two supports. Flexible members shall be incorporated in piping adjacent to all reciprocating equipment. Where steel supports contact copper lines, isolate copper from support with PVC sleeve to prevent galvanic corrosion.

1. Vertical Piping:

a. Wall mounted support spacing shall be on not more than 12' centers. Wall support shall be electro-galvanized pipe clamp with at least 12" of electro-galvanized 1-5/8" x 1-5/8" 12 gauge steel channel anchored to wall with at least two 1/4" Ramset plated threaded fasteners with 1" or more wall penetration.

b. Vertical pipes through floors shall be supported at each floor. Support shall consist of riser clamp. In addition to clamp, attach 1/2" dia. by 1/2" long stud to pipe just above clamp to prevent slipping of pipe. Stud shall be of same material as supported pipe.

2. Horizontal Piping: Clevis hangers blacksteel or approved equal with threaded rods and jamb nuts. Maximum pipe hanger spacing for Schedule 40 steel pipe shall be as follows:

a. 3/4" to 2" pipe on 8' centers with 3/8" rod.

b. 2-1/2" to 3" pipe on 10' centers with 1/2" rod.

c. 4" on 14' centers with 5/8" rod.

d. 6" to 8" pipe on maximum of 17' centers with 3/4" rod. (Use maximum 10' centers on precast plank.)

e. 8" pipe - 19' span with 7/8" rod.

3. Attachment to Structure:

a. Steel Joist Attachment: Grinnell #87 malleable iron "C" clamp (2" pipe and smaller) with lock nut and retaining clips. Grinnell #229 and #292 (2-1/2" pipe and larger) attach to upper or lower webb of joists as conditions require and only at panel joints, with two "C" clamps, and two rods, and two clevis hangers so that joist is symmetrically loaded. Line sizes 1-1/2" and smaller may be hung with only one hanger.

b. Steel Beam Attachment: Grinnell #87 malleable iron "C" clamp (2" pipe and smaller) with lock nut and retainage clips. Grinnell #229 and #292 (2-1/2" pipe and larger) attach to either upper or lower flange as field conditions require with one hanger.

c. Wood Beams and Purlins (for piping under 4" only): Grinnell #142 1/2" diameter lag screws with bolt thread head of black steel. Length shall penetrate not less than two-thirds of member depth. Use welded eye rods such as Grinnell #287 black steel of rod diameter specified above. Use 3/8" diameter lag screws for piping 1-1/2" and smaller.

d. Wood Trusses: Suspend piping from the building structure using one of the following methods:

i. Piping Under 2" Only: Install Grinnell #142 1/2" diameter lag screws with bolt thread head of block steel. Length shall penetrate not less than two-thirds of member depth. Use welded eye rods such as Grinnell #287 black steel of rod diameter specified above. Use 3/8" diameter lag screws for piping 1-1/2" and smaller.

ii. Piping 2" and Larger: Install uni-strut (trapeze) anchored to the top side of the roof truss bottom chord and then suspend down to a trapeze bar and/or a clevis hanger.

e. Concrete and Masonry Surfaces: Attachment to horizontal poured concrete surfaces shall be by concrete inserts or expansion sleeves. Attachment to vertical poured concrete surfaces or masonry surfaces shall be by concrete inserts, expansion sleeves, and Ramset or Hilte fasteners. Attachment to precast concrete construction shall be by use of rod passing through plank on joints and with plate not less than six times diameter of rod by 1/4" thick plus nut on top surface of plank.

f. Rooftop: Use prefabricated curb pipe support. Unit shall be built of not less than 18 gauge galvanized steel and constructed for use on the specific roof type for this project.

g. Roof-Top Equipment Supports:

i. Unless indicated otherwise on Drawings, roof-mounted equipment shall set on prefabricated equipment support rails. Support rails shall be of monolithic construction, 18 gauge galvanized steel, continuous mitred and welded corner seams, integral base plate, factory installed 2 x 4 wood nailer, and 18 gauge galvanized steel counter-flashing.

ii. Support height shall be selected so that support rails bear on metal or concrete roof deck and project minimum of 8" above top surface of roof, or as specified on drawings, and at least one foot beyond edge of equipment which it supports. See Drawings for possible additional requirements.

h. Anchors and Guides:

i. Anchor all pipes as required and/or where indicated in Contract Documents. Anchors shall properly distribute expansion and shall be securely attached to supporting construction to satisfaction of Architect's Field Representative.

ii. Provide semi-steel spider and guiding cylinder pipe alignment guides on all piping in all areas. Pipe alignment guides shall be spaced as required according to manufacturer's design criteria and recommendations (minimum of two guides on each side of expansion joints and loops). Pipe alignment guides shall serve to guide expanding pipe to move freely from anchor points to expansion joints, loops, or bends. Guides shall be of same manufacturer as expansion joints.

1.09 PUMPS

A. General: Pumps shall be sized and selected to provide specified flow rate at specified pressure difference. If pumps installed cannot provide both design conditions of flow rate and pressure difference, make any or all changes to pumps to achieve design conditions at no additional cost to Owner. This change may include, but is not necessarily limited to the following; change impeller size, change motor size, or change entire pump. If motor size is increased, resulting in electrical changes, Mechanical Contractor shall compensate Electrical Contractor for cost of change.

B. Piping connections to pumps shall be same size as pump connection or larger with reducing fittings installed as close as possible to pump connection.

C. Shut-off and check valves shall be same size as line size.

D. Elbows shall occur at least 7 pipe diameters from pump suction. (When used instead of suction diffuser.)

E. Piping shall be supported by other means than pump connections. Piping shall be properly supported before connections are made.

F. Avoid air pockets in suction piping; horizontal piping shall pitch up to pump.

G. Suction and discharge piping shall be provided with pressure gauges and needle valves.

H. Hot Water Circulating, and Miscellaneous Pumps:

1. Furnish and install pumps of size, type and capacity as indicated.

2. Pumps shall be complete with motors, pump base, couplers, seals, tapped gauge openings, etc. for complete assembly. In-line pumps may be installed without flex conditions.

3. Pumps shall be installed, aligned, and started in accordance with manufacturer's recommendations. Pump suction sizes shall not be less than those indicated in Schedule. Pumps shall be selected for and designed for quiet operation.

1.10 MOTORS

A. Ratings: Motors shall meet NEMA Standards and shall be capable of operating at rated load with voltage variation of plus or minus 10%, rated frequency variation of plus or minus 5%, or combined variation of 10% without damage to motor.

B. Selection: Motors shall be selected for type of service involved and shall be selected at minimum of 15% above required rating of equipment served. Provide "quiet rated" motors where required.

1.11 BELT AND SHAFT GUARDS

A. Requirements: All open drives on fans, pumps, compressors, and other similar drives shall be provided with guards in accordance with MIOSHA and all safety and construction codes.

B. Belt Drives: Compressors, fans, and equipment with sheave and pulley drives shall be provided with guards in accordance with MIOSHA and all safety and construction codes.

C. Coupling Drives: Direct motor coupling drives shall be provided with guards. Guards shall be extended to include shafts.

D. Extended Shafts: Equipment with extended shafts for dual bearings shall be provided with guards to cover entire shaft.

E. Walk-In Equipment: Equipment designed for walk-in service shall be provided with guards.

F. Guards: Guards shall be constructed of extra heavy gauge metal, formed to fit over protected items and securely fastened to equipment or floor. Provisions shall be made for access at test openings and allowance for motor adjustments. Guards shall allow for ample clearance of pulley, drives, and couplings. Guards shall be prime coated and finished in enamel to match their respective equipment.

1.12 ACCESS DOORS: Steel access doors and frames, factory-fabricated and assembled, complete with attachment devices and fasteners for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

A. Frames: 16-gage steel, with a 1-inch wide exposed perimeter flange.

1. For installation in masonry, ceramic tile, or wood paneling: 1-inch wide exposed perimeter flange and adjustable metal masonry anchors.

2. For gypsum wallboard or plaster; perforated flanges with wallboard bead.

3. For full-bed plaster applications; galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

B. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

2. Locking Devices: Flush, screwdriver-operated cam locks.

1.13 MECHANICAL IDENTIFICATION (also refer to Spec. 15.190)

A. General: All system components shall be identified to allow proper operation and maintenance.

B. Valve Identification: Label valves with brass tags on chain (1/2" letters). Prepare typewritten valve tag schedule indicating label, size, type, and function of each valve for inclusion in operation and maintenance manual. Also, mount plastic-encased copy of same in mechanical room.

C. Pipe Identification:

1. Label all pipes with stencil labeler (1-1/2" characters), this includes flow arrows.

2. Label all pipes where they are exposed, at change of piping direction, and every 50 feet at long straight runs.

D. Pipe and Duct Identification: All pipe covering, insulation work, and piping installed, except concealed or metal and aluminum foil jacketed work, shall be painted to match room/structure finish.

1.14 MECHANICAL SOUND, VIBRATION, AND SEISMIC CONTROL

A. General: Entire mechanical system shall be installed to provide quiet and vibration free environment in occupied spaces. Contractor shall replace or repair equipment and/or

provide additional sound and vibration control equipment if Architect/Engineer deems system or its components do not meet design criteria for sound and vibration.

B. Vibration Isolation Supports and Hangers:

1. All mechanical equipment over 1 horsepower, unless otherwise noted, shall be isolated from structure by means of resilient vibration and noise isolators supplied by single manufacturer. Where isolator type and required deflection are not shown or tabulated, equipment shall be isolated in accordance with latest version of ASHRAE Systems Handbook. Isolator manufacturer's submittal shall include complete design for supplementary bases, tabulation of design data on isolators, including outside diameter, free, operating, and solid heights of springs, free and operating heights of neoprene, or fiberglass isolators.

C. Pipe Hangers: Refer to Section 1.07.

D. Vibration Isolation and Expansion Compensation: Furnish and install all vibration isolators, flexible connections, expansion joints, and expansion loops required to reduce noise transmissions and stress on equipment and piping.

1. Vibration Isolation:

a. Locations: Floating slabs, fans, compressors, and all motor driven equipment subject to noise transmission.

b. Deflection: Selection to be made in conjunction with equipment manufacturers to assure workable system.

2. Expansion Joints:

a. General: Install piping for adequate movement without stress or damage. Provide sufficient expansion loops, changes in direction and within stress limits of ASME code. Where deflection cannot be employed to absorb expansion and contraction expansion joints should be employed.

b. Installation: Joints shall be properly anchored and guided in compliance with recommendations of manufacturer of expansion joint. Refer to Paragraph 1.06.C.4.g for anchors and guides.

3. Flexible Connections:

a. General: All equipment subject to vibration and noise transmission shall be provided with flexible connections.

b. Compressors: Braided steel or bronze.

c. Pumps: Braided steel or bronze. When using the Victaulic pipeline system, three Victaulic Style 75 or 77 flexible couplings may be used in lieu of a flex connector. See Victaulic TS-5000 for details.

d. Duct Connections to Air Moving Equipment: Neoprene coated flame-proof fabric minimum 2" side.

E. Spin Balance: All new rotating equipment shall be factory balanced, both statically and dynamically. If any equipment is determined by Architect/Engineer to be unbalanced after installation, equipment shall be electronically in-place spin balanced according to balancing criteria as set forth in latest *Systems Edition of ASHRAE Handbook.* Before and after readings shall be submitted in writing for Architect/Engineer's review.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL - PIPING

A. Installation:

1. Establish elevations of buried piping outside the building to ensure not less than minimum cover by code.

2. Establish invert elevations, slopes for drainage to 1/8" per foot, one percent minimum. Maintain gradients.

3. Install valves with stems upright or horizontal, not inverted.

4. Install unions downstream of valves and at equipment or apparatus connections.

5. Install brass male adaptors each side of valves in copper piped system. Sweat solder adaptors to pipe.

6. Install nail stoppers at all pipe/wall stud intersections (both sides). Nail stoppers to be equal to Simpson "Strong-Tie" Model "NS".

B. Testing: Refer to individual piping system specification sections for testing specifications. If testing specifications are not given in individual section, test piping system as follows:

1. Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
   a. Required test period is 2 hours.
   b. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.

   c. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

   d. Record date of each test and results in a log which shall be turned over to Architect/Engineer at completion of Project.

2. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-lead compounds, mastics, or other temporary repair methods.

C. Disinfection of Domestic Water Piping System:

1. Prior to starting work, verify system is complete, flushed, and clean.

2. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

3. Inject disinfectant - free chlorine in liquid, powder, tablet, or gas form - throughout system to obtain 50 to 80 mg/L residual.

4. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

5. Maintain disinfectant in system for 24 hours.

6. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

7. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

8. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601.

3.02 FIELD QUALITY CONTROL - DUCTWORK

A. Installation:

1. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.

2. Provide fire dampers or combination fire and smoke dampers at locations where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings, and hinges.

3. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.

4. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

5. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

6. Provide support for all diffusers/grilles in any ceiling structure with a non-exposed-to-view support system. System is to support diffuser/grille and associated ductwork without adding weight to ceiling tile.

B. Duct Sealants:

1. Duct systems, including all seams, joints, fastener penetrations and connections, shall be effectively sealed in accordance with SMACNA Seal Class A requirements, and

leak tested with total allowable leakage from high and medium pressure (4" W.C. or greater) ducts not to exceed one (1) percent of the total system design airflow rate. Joint sealants shall have fire and smoke hazard rating as tested by ASTM D-2202 Exterior mastic sealant shall be certified to pass 500 hours QUV. Sealants shall also comply with ASTM freeze/thaw standard C731 and D2202.

2. Manufacturer, upon request shall be able to properly document an established record of experience and success in the specialized formulation of duct sealants, elastomeric tapes, and adhesives.

3. All duct work shall be suitably cleaned and prepared, and sealant applied in strict accordance with manufacturer's recommendations for cure time shall be followed before pressure testing is begun. Any additional paint or coatings must conform to manufacturer's specifications.

4. Sealant Manufacturer: **AMF Safecoat Dynoflex, United Duct Sealer (Water based Uni-Mastic 181)**

3.03 SELECTIVE DEMOLITION

A. Demolish, remove, demount, and disconnect abandoned mechanical materials and equipment indicated to be removed and not indicated to be salvaged or saved. Where noted or indicated to be removed, that portion of the existing mechanical systems are to be disconnected, taken down, removed from Owner's property and properly disposed of by the Contractor.

B. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing mechanical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

1. Where noted or indicated to be removed and turned over to the Owner, that portion of the existing mechanical systems are to be disconnected, taken down and moved to a location where the Owner wants it stored.

2. Where noted or indicated to be removed and reused, that portion of the existing mechanical systems are to be disconnected, taken down, stored in a clean, dry location by the Contractor until such time as the Contractor shall reinstall. The portions of the reused mechanical system which can be cleaned of rust, sludge, etc. shall be cleaned before reinstalling. If existing surfaces are painted, such surfaces shall be touch-up painted or repainted after reinstallation.

C. Job Conditions:

1. While the drawings indicate certain existing mechanical systems or other materials are to be reused or removed, Contractor shall not consider these notations as showing all items in the area. The notations are general in nature and are to establish the intent and nature of work and apply to all mechanical items in the area.

2. Certain mechanical materials that must be removed are concealed in walls or ceilings are not shown but shall be removed when walls are removed at no cost to the Owner.

3. If the existing occupied facility is to stay in operation throughout the entire remodeling period, mechanical services for the occupied facility shall be completely operable and shall function continuously while remodeling work is completed.

4. **Mechanical Materials and Equipment:** Demolish, remove, demount, and disconnect the following items:

   a. Inactive and obsolete HVAC equipment, piping, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.

   b. Piping and ducts imbedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.

   c. Installation and Removal: Where walls are to be removed and existing piping or ductwork is uncovered which must be reused to serve a section of the building other than this remodeling area, it shall be this Contractor's responsibility to reroute and provide permanent piping to replace that which is removed. Unused piping and ductwork shall be removed to 2" below disturbed surfaces and capped.

END OF SECTION 23 05 00
BASIC MECHANICAL MATERIALS & METHODS

NOTE: THESE SPECIFICATIONS ARE THE PROPERTY OF THE ENGINEER AND ARE NOT TO BE REUSED OR REPRODUCED WITHOUT WRITTEN PERMISSION. THIS SPECIFICATION IS COPYWRITTEN.

SECTION 23 05 16

EXPANSION COMPENSATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Flexible pipe connections.

B. Expansion joints and compensators

C. Pipe loops, offsets, and swing joints.

1.02 RELATED WORK

A. Section 23 05 29 - Supports and Anchors.

1.03 REFERENCES

A. Conform to Standards of Expansion Joint Manufacturer's Association.

1.04 DESIGN CRITERIA

A. Base expansion calculations on 50 degrees F installation temperature to 210 degrees F for hot water heating and 140 degrees F for domestic hot water, plus 30 percent safety factor.

1.05 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 00 00.

B. Flexible pipe connector shop drawing data to include maximum allowable temperature and pressure rating, overall face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, and braid structure and total number of wires in braid.

C. Expansion joint shop drawings to include maximum allowable temperature, pressure rating, and maximum expansion compensation.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTIONS

A. For steel piping, construct with stainless steel inner hose and braided exterior sleeve.

B. For copper piping, construct with bronze inner hose and braided exterior sleeve.

C. Construct spool pieces to exact size for insertion of flexible connection.

D. Use connections suitable for minimum 125 psi WSP and 450 degrees F and 200 psi WOG and 250 degrees F.

2.02 EXPANSION JOINTS

A. Steel Piping 3 inch and under: Stainless steel bellows type with anti-torque device, limit stops, and internal guide.

B. Steel piping over 3 inch: External ring controlled type with hydraulically formed stainless steel bellows.

C. Copper Piping: All bronze type with two-ply bronze bellows, anti-torque device limit stops, internal guides, and solder joint end.

D. Use joints suitable for minimum 125 psi WSP and 400 degrees F, and 200 psi WOG and 250 degrees F.

E. Copper or Steel Piping 2 inch and Under: Low pressure compensators with two-ply bronze bellows suitable for min. 75 psi pressure & 250 degrees F, & max. 1/2 inch expansion.

F. Copper or Steel Piping 2 inches and Over: Copper type with packed sliding sleeve suitable for minimum 125 psi working pressure and 250 degrees F.

2.03 PIPE LOOPS, OFFSETS, AND SWING JOINTS.

A. Conform to ASHRAE 1988 Equipment Handbook, ASME 1983 Power Piping Standard, and ASME 1982 Building Services Piping.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine piping layout and add additional anchors or expansion joints required to adequately protect system.

B. Provide inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations.

3.02 INSTALLATION

A. Install expansion joints where indicated, and elsewhere as determined by installer for adequate expansion of installed piping system. Install in accordance with manufacturer's instructions. Provide pipe anchors and pipe alignment guides as indicated, and in accordance with manufacturer's recommendations. Align units properly to avoid end loading and torsional stress.

B. Fabricate expansion loops as indicated, in locations indicated, and elsewhere as determined by installer for adequate expansion of installed piping system. Subject loop to cold spring which will absorb 50% of total expansion between hot and cold conditions. Provide pipe anchors and pipe alignment guides as indicated, and elsewhere as determined by installer to properly anchor piping in relationship to expansion loops.

C. Flexible Expansion Loops may be installed in place of fabricated expansion loops.

END OF SECTION 23 05 16
EXPANSION COMPENSATION

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SECTION 23 05 23

VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Gate valves.

B. Globe or angle valves.

C. Ball valves.

D. Check valves.

E. Butterfly valves.

F. Drain valves.

G. Hose bibs.

H. Auto Flow Valves

1.02 RELATED WORK

A. Section 23 05 00 - Materials and Methods

B. Section 22 40 10 - Plumbing Specialties.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 23 00 00.

B. Submit detailed shop drawings under provisions of Section 23 00 00. Clearly indicate make, model, location, type, size pressure rating, end connection details, seating materials, trim material, and arrangement.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide valves of same manufacturer throughout where possible.

B. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

C. See Specification Section 23 00 00.

2.02 VALVE CONNECTIONS

A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.

B. Thread pipe sizes 2 inches and smaller.

C. Flange pipe sizes 2-1/2 inches and larger.

D. Solder or screw to solder adapters for copper tubing.

E. Use grooved body valves with mechanical grooved jointed piping.

F. Provide butterfly valve with tapped lug body when used for isolating service.

2.03 GATE VALVES

A. Gate Valves, 2-Inches and Smaller:

MSS SP-80; Class 125, body and bonnet of ASTM B 62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires. Use for domestic hot and cold water only.

B. Gate Valves, 2-Inches and Smaller:

MSS SP-80; Class 150, body and union bonnet of ASTM B 62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Use for hot water.

C. Gate Valves, 2-1/2 Inches and Larger:

MSS SP-70; Class 125 iron body, and bonnet conforming to ASTM A 126 Class B; with flanged ends, "Teflon" impregnated packing, and two-piece backing gland assembly.

2.04 GLOBE VALVES

A. Globe Valves, 2-Inches and Smaller:

MSS SP-80; Class 125; body and screwed bonnet of ASTM B 62 cast bronze; with threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.

B. Globe Valves, 2-1/2 Inches and Larger:

MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing, and two-piece backing gland assembly.

2.05 BALL VALVES

A. Ball Valves, 1 Inch and Smaller:

Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; two-piece construction; with bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball and stem, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem design, and vinyl-covered steel handle.

B. Ball Valves, 1-1/4 Inch to 2 Inches:

Rated for 150 psi saturated steam pressure, 400 psi WOG pressure, 3-piece construction; with bronze body conforming to ASTM B 62, conventional port, chrome-plated brass ball and stem, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem design, and vinyl-covered steel handle.

2.06 CHECK VALVES

A. Swing Check Valves, 2-1/2 Inches and Larger:

MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

B. Wafer Check Valves:

Class 250, cast-iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.

C. Lift Check Valves, 2-Inches and Smaller:

Class 125; cast-bronze body and cap conforming to ASTM B-62; horizontal or angle pattern, lift-type valve, with stainless steel spring, bronze disc holder and renewable "Teflon" disc, and threaded ends. Provide valves capable of being refitted and ground while the valve remains in the line.

D. Swing Check Valves, 2-Inches and Smaller:

MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

2.07 BUTTERFLY VALVES

A. Butterfly Valves, 2-1/2 Inch and Larger:

MSS SP-67; rated at 200 psi; cast-iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, nickel-plated ductile iron disc, stainless steel stem, and EPDM 0-ring stem seals. Provide lever operators with locks for sizes 2 through 6 inches and gear operators with position indicator for sizes 8 through 24 inches. Provide lug or wafer type as indicated. Drill and tap valves on dead-end service or requiring additional body strength.

2.08 DRAIN VALVES

A. Threaded Ends 2 Inch and Smaller: Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4" hose outlet connection.

B. Soldered Ends 2 Inch and Smaller:

Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4" hose outlet connection.

2.09 REDUCED PRESSURE PRINCIPLE VALVES

A. The backflow preventer shall be a Reduced Pressure Principle and shall include a tightly closing resilient-seated shut-off valve on each end of the body. The assembly shall be fitted with four (4) properly located resilient-seated test cocks.

The assembly shall have two (2) independent and internally loaded check valves and a pressure differential relief valve located between the check valves.

The backflow preventer shall be suitable for supply pressure up to 175 psi and water temperatures from 33 to 180EF.

The backflow preventer shall meet the requirements of the following standards: USC's FCCC & HR Manual, Sec. 10 ASSE 1013, AWWA C-511, IAPMO, CSA B64.4, and UL.

B. Provide piping to drain as required.

2.10 HOSE BIBS

A. Bronze or red brass, replaceable hexagonal disc, hose thread spout, chrome plated where exposed.

B. Non-freeze type with chrome plated wall plate hose thread spot, removable key.

2.11 SELECT VALVES (with the following ends or types of pipe/tube connections):

A. Copper Tube Size, 2-Inches and Smaller:

Solder ends, except provide threaded ends to match existing conditions.

B. Steel Pipe Sizes, 2-Inches and Smaller:
Threaded or end.

C. Steel Pipe Sixes 2-1/2 Inches and Larger:

Flanged ends.

2.12 AUTO FLOW VALVES

A. Automatic flow control valve cartridges shall automatically control flow rates with ±5% accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Four operating pressure ranges shall be available with the minimum range requiring less than 3 PSID to actuate the mechanism.

B. Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.

C. Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance. (Consult the factory for details).

D. All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale.

E. Body Styles

Isolator™ Series Valve (IY, IR)

1. Isolator series valves, sizes 1/2" through 1-1/2", shall have a ASTM brass alloy body, rated at no less than 400PSI/250°F. Isolator series valves, sizes 1-1/2" Large through 3", shall have a CAST brass alloy body, rated at no less than 275PSI/250°F. These sizes shall be constructed in a one-piece body to include a handle ball valve, a flow control cartridge assembly, dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes combined with a manual air vent, and a union end which will accept various end pieces. The IY shall include a removable 20 mesh stainless steel strainer. Available flow rates shall be from 0.25 GPM to 160.0 GPM.
2. The body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections.
3. The body design shall allow inspection or repair of handle operated stem without disturbing piping connections. The repairable stem shall include two Teflon seals and one EPDM o-ring for protection against chemicals and modulating temperature.
4. The valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.

PART 3 - EXECUTION

3.01 INSTALLATIONS

A. General Application:

Use gate or ball valves for shut-off duty, use globe valve where indicated. Ball valves may be substituted for gate valves limited by requirements of this section. Refer to piping system specification sections for specific valve applications and arrangements. Install valves where indicated and where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping serving two or more terminal units or fixtures. Locate valves so as to be accessible.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install valves in horizontal piping with stem at or above the center of the pipe. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

E. Insulation:

Where insulation is indicated on cold water systems install extended-stem valves or handles arranged in proper manner to receive insulation.

F. Install valves in a position to allow full stem movement.

G. Install drain valves at low points of all systems.

END OF SECTION 23 05 23
VALVES

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SECTION 23 05 29

SUPPORTS & ANCHORS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Pipe, duct, and equipment hangers, supports, and associated anchors.

B. Sleeves and seals.

C. Flashing and sealing equipment and pipe stacks.

1.02 RELATED WORK

A. Section 23 05 16 - Expansion Compensation

B. Section 23 07 00 - Thermal Insulation

1.03 REFERENCES

A. Conformance with ANSI/ASME B31.1 - Power Piping.

B. Conformance with NFPA 13 - Standard for the Installation of Sprinkler Systems.

C. Conformance with Manufacturer's Standardization Society MSS SP-90.

1.04 SUBMITTALS

A. Submit product data under provisions of Section 23 00 00.

B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 2 Inch: Malleable iron carbon steel, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2-1/2 to 4 Inches and Cold Pipe Sizes 6 Inches and Over: Carbon steel, adjustable, clevis.

C. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for hot pipe sizes 6 inches and over.

E. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

F. Wall Support for Pipe Sizes to 4 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe sizes 6 inches and over.

G. Vertical Support: Steel riser clamp.

H. Floor Support for Pipe Sizes to 4 Inches and all Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

I. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

J. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

K. Shield for Insulated Piping 2 Inches and Smaller: 18 gauge galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.

L. Shield for Insulated Piping 2-1/2 Inches and Larger (Except Cold Water Piping): Pipe covering protective saddles.

M. Shields for Insulated Cold Water Piping 2-1/2 Inches and Larger: Hard block non-conducting saddles in 90° segments, 12“ minimum length, block thickness same as insulation thickness.

2.02 HANGER RODS

A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 FLASHING

A. Metal Flashing: 26 gauge galvanized steel.

B. Flexible Flashing: 47 mil thick sheet compatible with roofing.

C. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

2.05 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Floors: Form with steel pipe or 18 gauge galvanized steel.

B. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed.

C. Sleeves for Round Ductwork: Form with galvanized steel.

D. Sleeves for Rectangular Ductwork: Form with galvanized steel or wood.

E. Fire Stopping Insulation: Glass fiber, type, foam or cement type to be equal or greater than rating of structure being penetrated.
F. Caulk: Acrylic sealant.

2.06 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

C. Provide copper plated hangers and supports for copper piping.

2.07 FINISH

A. Prime coat or factory galvanize exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 EXECUTION

3.01 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut flush with top of slab.

3.02 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
1/2 thru 1-1/4 inch	6'-6"	3/8"
1-1/2 thru 2 inch	10'-0"	3/8"
2-1/2 thru 3 inch	10'-0"	1/2"
4 thru 6 inch	10'-0"	5/8"
8 thru 12 inch	14'-0"	7/8"
PVC (All Sizes)	6'-0"	3/8"
C.I. Bell and Spigot (or No-Hub)	5'-0" and at Joints	1/2"

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

3.03 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of concrete type specified by architect or on drawings.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct support of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.04 FLASHING

A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipe through outside walls, turn flanges back into wall and caulk, metal counter flash and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor, shower, and mop sink drains watertight to adjacent materials.

E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacture's instructions for sound control.

F. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface (or as indicated on drawings). Flexible sheet flash and counter flash with sheet metal; seal watertight.

3.05 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.

C. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

D. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION 23 05 29
SUPPORTS & ANCHORS

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SECTION 23 05 48

VIBRATION ISOLATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Vibration Isolation Equipment.

1.02 RELATED WORK

A. Section 22 11 16 - Plumbing Piping.

B. Section 23 25 00 - Hydronic Piping.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Vibration isolation equipment is described hereinafter by Mason Industries, Inc. catalog or model numbers, and is intended to convey type and quality of equipment required. Similar products made by other manufacturers may be used:

    a. Hyspan
    b. Flexonics
    c. Mason
    d. Metraflex

B. Design Criteria:

1. The mount shall have a vibration transmissibility not exceeding 5 percent at a frequency equal to the lowest rotational speed of the system being isolated. The springs shall have a minimum static deflection of 1-inch and shall have a diameter of not less than the deflected height of the spring under the imposed loads. All springs shall be selected for uniform static deflections according to distribution of weight.

2. All mountings used out of doors shall have hot dipped galvanized hardware and PVC coated springs.

3. Separate snubbing and damping control, and horizontal and vertical stabilizer shall be used when required to control oscillations and equipment thrust.

4. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition.

C. Testing Agency:

The Contractor shall engage the manufacturer of the vibration isolation equipment to inspect and, where required, to adjust, repair and/or add isolators to comply with the intent of the specifications.

1.04 SUBMITTALS

A. Submittal data shall include detailed calculations showing weight distribution of equipment, load, type, and deflection of each isolator.

B. Upon completion of the inspection and after the required adjustments are made, the isolation equipment manufacturer shall submit in accordance with SECTION 23 00 00, MECHANICAL GENERAL PROVISIONS, his report detailing actual static deflection versus designed static deflection for each isolator.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATION EQUIPMENT

A. Elastomeric Isolators:

1. Elastomeric isolators shall be double deflection neoprene mountings having a minimum static deflection of 0.50 inches. All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided for these areas where bolting is required. Mountings shall be Type ND.

2. On equipment such as small vent sets, steel rails shall be used above the mountings to compensate for the overhang. Mountings shall be rails Type DNR.

B. Free-Standing Spring Isolators:

1. Spring type isolators shall be free standing and laterally stable without any housing and complete with 1/4 inch neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height. Mountings shall be Type SLF.

2. Free-standing spring isolators shall be provided for the following:

   a. Belt-driven centrifugal fans and motors

C. Hangers for Ductwork, Fans & Unit Heaters:

1. Vibration hangers shall contain a steel spring located in a neoprene cup, manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Hangers shall be provided with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps.

2. Submittals shall include a scale drawing of the hanger showing the 30-degree capability. Hangers shall be Type W30.

D. Flexible Duct Connectors:

1. Laminated flexible sheet of cotton duck and sheet elastomer (butyl, neoprene or vinyl), reinforced with steel wire mesh where required for strength to withstand duct pressure. Form connectors with full-faced flanges and accordion bellows to perform as flexible isolation unit, and of manufacturer's standard length for each size unless otherwise indicated. Equip each unit with galvanized steel retaining rings for airtight connection with ductwork.

E. Flexible Pipe Connectors:

1. For non-ferrous piping, provide bronze hose covered bronze wire braid with copper tube ends or bronze flanged ends, brazewelded to hose.

PART 3 - INSTALLATION

3.01 General

A. Except as otherwise indicated, apply the following types of vibration isolators at indicated locations or for indicated items of equipment. Selection is Installer's option where more than one type is indicated.

1. Neoprene-Pad-Type Isolated:

Install where the following equipment is indicated:

Air compressors.

2. Spring isolators:

Install where the following floor-mounted equipment is indicated:

Air-handling units.

Note: Some Air-handling units may be internally isolated and may not require spring isolators.

3. Isolation Hangers:

Install where the following ceiling-mounted equipment is indicated:

Exhaust Fans
Cabinet Unit Heaters

4. Flexible Duct Connectors:

Install at the following ductwork connections:

Connections with vibration-isolation-mounted air handling equipment, exhaust fans, cabinet unit heaters, etc.

5. Flexible Pipe Connectors:

Install in piping systems at the following locations:

Connections with vibration-isolation-mounted equipment, includes air handling units.

3.02 Installation

A. Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.

B. Bond flanges of flexible duct connectors to ducts and housings to provide airtight connections. Seal seams and penetrations to prevent air leakage.

C. Install flexible pipe connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.

END OF SECTION 23 05 48
VIBRATION ISOLATION

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SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Identification of mechanical products installed under Division 23 00 00.

1.02 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 23 00 00.

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

PART 2 PRODUCTS

2.01 MATERIALS

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.

C. Metal tags: Brass with stamped letters.

D. Stencils: With clean cut symbols and letters of the following size:

OUTSIDE DIAMETER OF INSULATION OR PIPE	LENGTH OF COLOR FIELD	SIZE OF LETTERS
3/4" - 1-1/4"	8"	1/2"
1-1/2" - 2"	8"	3/4"
2-1/2" - 6"	12"	1-1/4"
Equipment	---	2-1/2"

E. Stencil Paint: Semigloss enamel.

F. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

G. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

H. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6" wide by 4 mil. thick, manufactured for direct burial service.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Plastic or Metal Nameplates: Install with corrosive-resistant mechanical fasteners, adhesive or corrosive-resistant chain.

B. Plastic Tape or Plastic Pipe Markers: Install complete around pipe in accordance with manufacturer's instructions.

C. Equipment: Identify air handling units, pumps, tanks, heat transfer equipment, condensing units, and air compressors with plastic nameplates. Small devices, such as in-line pumps, may be identified with plastic or metal tags.

D. Controls: Identify control panels and major control components outside panels with plastic nameplates.

E. Piping: Identify piping, concealed or exposed, with plastic tape pipe markers or stenciled painting. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure, and at each obstruction.

F. Underground Plastic Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.03 MECHANICAL IDENTIFICATION SCHEDULE

A. Domestic hot and cold water piping, natural gas piping, heating hot water supply and return piping, chilled water supply and return piping, tanks, air handling units, condensing units, condensers, exhaust fans, return fans, pumps and heat transfer equipment.

B. Provide valve chart and schedule in frame with glass or clear plastic cover. Install in Mechanical Room.

END OF SECTION 23 05 53
MECHANICAL IDENTIFICATION

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SECTION 23 05 93

TESTING, ADJUSTING and BALANCING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Owner shall contract with an independent testing, adjusting, and balancing (TAB) agency to test, adjust, and balance the HVAC systems. This contractor shall perform TAB work solely and exclusively as their primary source of business.

B. The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting, and balancing the HVAC and Hydronic systems, as described in these specifications and/or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results.

C. The items requiring testing, adjusting, and balancing are described in detail in section 1.06 and generally include the following:

AIR SYSTEMS:
Air Moving Equipment
Exhaust Fans
Zone Branch and Main Ducts
Diffusers, Registers and Grilles
Energy Recovery Units

HYDRONIC SYSTEMS:
Pumps
System Mains and Branches
Coils

1.02 RELATED SECTIONS

A. Section 23 00 00 - Mechanical General Provisions.

B. Section 23 05 00 - Basic Mechanical Materials and Methods.

C. Section 23 21 19 - Hydronic Piping.

D. Section 25 51 00 - Sequence of Operations

E. Section 25 00 00 – Building Control System.

1.03 DEFINITIONS, REFERENCES, STANDARDS

A. The following is a list of standards that this work shall be performed and submitted in accordance with. It is the responsibility of this contractor to adhere to the more stringent specifications of these different standards to meet the requirements this section.

B. AABC National Standards for Total System Balance (2002 Edition)

C. ASHRAE - 1989 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.

D. SMACNA B HVAC Systems Testing, Adjusting & Balancing (Third Edition - August, 2002)

E. TABB-Testing, Adjusting, and Balancing Bureau (Current Edition)

F. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems (1998, Sixth Edition).

1.04 ALLOWANCES

A. Installation is included as part of this Section and is to be included in the Contract Sum.

1.05 BALANCING AGENCY QUALIFICATIONS

A. An impartial, independent Test & Balancing Company will provide the TAB services required for this project. This contractor shall specialize in performing TAB work solely and exclusively as their primary source of business. This Company shall have performed TAB work on projects similar in size and scope and shall be prepared to provide documented proof of such as requested by the engineer, architect and owner.

B. Agency Qualifications: The TAB Company shall be a current and certified member of a Test & Balance institution that offers comprehensive training and certification of its members or they shall be a TAB company specializing in this type of work with a minimum of 5 years documented work experience. The TABB company shall be prepared to submit records of experience in the field of air and hydronic system balancing or any other data as requested by the Engineer.

C. Final Approval: Note that the Owner, Architect, and Engineer shall select and make the FINAL APPROVAL of the TABB Contractor for this project.

Approved Balancing Company:

1. Integrity Test & Balance, Inc., Traverse City, MI, Phone-231-929-0940, Fax-231-929-0949
2. Great Lakes Balancing, Grand Rapids, MI, Phone 616-813-7384

D. Procedures and Agenda: The TAB Company shall submit the TAB procedures and agenda proposed to be used.

E. Sample Forms: The TAB Company shall submit sample forms, which shall include the minimum data required as set forth in these specifications.

F. Provide bound reports with a cover page, letter size, manuals, complete with index page and/or tabs.

1.06 SUBMITTALS

A. Submit name of independent adjusting and balancing agency for approval, see Specification Section 23 00 00.

B. Submit test reports as a submittal under provisions of Section 23 00 00.

1.07 TAB PREPARATION AND COORDINATION

A. It will be necessary for the TABB Company to perform his services in close coordination with the Mechanical Contractor on a critical path network. It is the TABB Companies responsibility to initiate this continuing coordination to determine his schedule for final

testing and balancing services and periodic inspections required during construction.

B. Shop drawings, submittal data, up-to-date revisions, change orders, and other data required for planning, preparation, and execution of the TAB work shall be provided by the Mechanical Contractor or General Contractor to the TAB Company no later than 60 days prior to the start of TAB work. This information shall include but not necessarily limited to the following:

1. Project drawings and specification.

2. Approved construction revisions pertaining to the HVAC systems.

3. Approved submittal data on HVAC and Hydronic equipment and systems to be installed by the mechanical contractor.

4. Approved HVAC and Hydronic shop drawings.

5. Approved Temperature Control System wiring diagrams, submittals and system diagrams.

1.08 MECHANICAL CONTRACTOR RESPONSIBILITES

A. The Mechanical Contractor shall complete the installation and start-up of all HVAC systems to ensure they are working properly and shall perform all other items as described hereinafter to assist the TABB Company in performing the testing and balancing of the HVAC and Hydronic systems.

B. Air Distribution Systems:

1. Verify installation for conformity to design, manufacturer guidelines and industry standards.

2. Terminate all exhaust ducts, and pressure test them for leakage, as required by the specifications.

3. Ensure that all volume, splitter, extractor and fire dampers are properly located, functional and open. Volume dampers found to be non-functional or obstructed for proper adjustment shall be repaired/replaced by this mechanical contractor. Dampers serving outside, return, and relief air shall provide for tight closure and full opening, with smooth free operation.

4. All volume damper handles and manual locking quadrants shall be freely visible and exposed for identification and use. These devices found to be covered over by duct installation shall require the mechanical contractor and/or the insulation contractor to survey **all** of the installed volume dampers and correct such measures at no additional cost to the owner.

5. Verify that all supply, return, exhaust and transfer grilles, registers, diffusers and high pressure terminal units are open and installed for proper operation.

6. Ensure that all HVAC units and associated apparatus, such as heating and cooling coil line penetrations, filter sections, mixing box sections, access doors etc., are blanked and/or sealed to eliminate excessive bypass or leakage of air.

7. Ensure that all fans (supply, return, relief and exhaust) are operating and free of vibration and drives packages are checked for proper rotation and belt tension. Overload protection devices shall be of proper sizing and rating as verified by Electrical Contractor and confirmed to the Mechanical Contractor.

8. Make any necessary changes to the fan sheaves, belts, and dampers as required by the TABB Company at no additional cost.

9. Insure that all HVAC units have newly installed and clean air filters prior to commencing with the air balance.

C. Water Circulating Systems@

1. Verify installation for conformity to design, manufacturer guidelines and industry standards.

2. Check all pumps to verify proper pump and motor coupling alignment and rotation.

3. Ensure that systems have been flushed, cleaned, construction strainers removed from pumps and final strainers installed for normal operation. System shall be properly be filled to operating pressure and expansion tanks pressurized accordingly.

4. Check all pump motors for current and voltage to ensure that motors do not exceed manufacturers name plate FLA amperage rating.

5. Overload protection devices shall be of proper sizing and rating as verified by Electrical Contractor and confirmed to the Mechanical Contractor.

6. Check and set operating temperatures of heat exchangers, boilers and fuel fired equipment to manufacturers and design requirements.

1.09 BUILDING CONTROL CONTRACTOR RESPONSIBILITIES

D. The building control system shall be complete and operational. The Building Control System contractor shall install all necessary computers and computer programs, and make these operational. Assistance shall be provided by the Building Control System contractor as required for reprogramming, coordination, and problem resolution. This should include but not be limited to the following:

1. Making final adjustments for minimum outdoor air on AHU's, RTU's and other pertinent HVAC equipment.

2. Making final adjustments for variable frequency drives for VAV systems and recording of final static pressure set point.

3. Making global commands for all heating valves to go open for preparation of proper water balance procedures.

4. The building controls contractor shall allow sufficient time as necessary in the project to provide the assistance and instruction to the TABB Company in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers, or any other device that may require set

points changes so that the TABB Company can properly perform the required work.

1.10 REPORTS

A. Final TAB Report - The TAB Company shall submit the final TAB report for review by the engineer. All outlets, devices, HVAC equipment, etc. shall be identified, along with a numbering system corresponding to report unit identification. The TAB company shall submit an Project Performance Certification and Guaranty, assuring that the project systems were tested, adjusted, and balanced in accordance with the project specifications. Submit four (4) copies of the report form for final approval.

B. Forms shall include the following information:

1. Title Page

2. Air Moving Equipment:
   a. Location
   b. Manufacturer
   c. Model
   d. Serial Number
   e. Air flow, specified and actual
   f. Return air flow, specified and actual
   g. Outside air flow, specified and actual
   h. Total static pressure and external static pressure, specified and actual
   i. Component (coils, filters, air blenders etc.) static pressure drop, specified and actual
   j. Inlet pressure
   k. Discharge pressure
   l. Fan and motor RPM, design and actual
   m. Sheave size, manufacturer's model number.
   n. Belt size, manufacturer and center distance from motor shaft to fan shaft.

3. Exhaust Fan Data:
   a. Location
   b. Manufacturer
   c. Model
   d. Air flow, specified and actual
   e. Total static pressure (total external), specified and actual
   f. Inlet pressure
   g. Discharge pressure
   h. Fan and motor RPM, design and actual
   i. Sheave size, manufacturer's model number.
   j. Belt size, manufacturer and center distance from motor shaft to fan shaft.

5. Return Air/Outside Air Data:
   a. Identification/location
   b. Design combined air flow
   c. Actual combined air flow
   d. Design return air flow
   e. Actual return air flow
   f. Design outside air flow
   g. Actual outside air flow

6. Electric Motors:
   a. Manufacturer
   b. HP/BHP
   c. Phase, voltage, amperage; nameplate, actual.
   d. RPM, nameplate and actual
   e. Service factor
   f. Starter size, rating, heater elements
   g. Motor sheave size, manufacturer number, number of turns open-actual.

7. Duct Traverse:
   a. System zone/branch
   b. Duct size
   c. Area
   d. Design air flow
   e. Test velocity
   f. Test air flow
   g. Duct static pressure
   h. Air temperature

8. Air Distribution Test Sheet:
   a. Air terminal number
   b. Room number/location
   c. Terminal type-manufacturers model number
   d. Terminal size-duct/collar connection size.
   e. Area factor if flow hood is not used
   f. Design air flow
   g. Test (final) velocity/air volume

9. Pump Data
   a. Identification/number
   b. Manufacturer
   c. Size/model
   d. Impeller
   e. Service
   f. Design flow rate, pressure drop
   g. Actual flow rate, pressure drop
   h. Discharge pressure
   i. Suction pressure
   j. Total operating head pressure
   k. Shut off, discharge and suction pressures
   l. Shut off, total head pressure-verify impeller size.

10. Hydronic Equipment
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Air flow, design and actual
    f. Water flow, design and actual
    g. Water pressure drop, design and actual
    h. Air pressure drop, design and actual
    i. Circuit setter manufacturer, size, model number, required pressure drop for design flow rate.
    j. Circuit setter adjustment setting, final pressure drop and corresponding flow rate.

11. Test Instrument Inventory and Calibration

    a. Test Instrument
    b. Manufacturer
    c. Model Number
    d. Serial Number
    e. Type-Analog, electric, digital
    f. Application for testing
    g. Date of most recent calibration. Note: N.I.S.T certification of calibration will be provided upon request for proof of compliance.

1.11 DEFICIENCIES

A. Any deficiencies in the installation or performance of a system or component observed by the TAB Company shall be brought to the attention of the construction manager or his on site representative.

B. The work necessary to correct items on the deficiency listing shall be performed and verified by the affected contractor before the TAB Company returns to retest. Unresolved deficiencies shall be noted in the final report.

PART 2 - EXECUTION

2.01 GENERAL

A. The specified systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting, and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with standards set forth in section 1.03

B. Equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls and devices shall be marked to show final settings.

C. All information necessary to complete a proper TAB project and report shall be per the standards in section 1.03, unless otherwise noted. The descriptions for work required, as listed in this section, are a guide to the minimum information needed.

3.02 EXAMINATION

A. Before commencing work, verify that systems are complete and operable. Ensure the following:

    1. Equipment is operable and in a safe and normal condition.

    2. Temperature control systems are installed complete and operable.

    3. Proper thermal overload protection is in place for electrical equipment.

    4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

    5. Duct systems are clean of debris.

6. Correct fan rotation.
7. Fire and volume dampers are in place and open.
8. Coil fins have been cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage has been minimized.
12. Hydronic systems have been flushed, filled, and vented.
13. Correct pump rotation.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Report any defects or deficiencies noted during performance of services to the Engineer.

C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.04 INSTALLATION TOLERANCES

A. Adjust air handling systems to plus or minus 10 percent for supply systems and plus or minus 10 percent for return and exhaust systems from figures indicated.

B. Adjust hydronic systems to plus or minus 10 percent of design conditions indicated.

3.05 ADJUSTING

A. Adjust work under provisions of Section 23 00 00.

B. Recorded data shall represent actually measured, or observed condition.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.06 AIR SYSTEM PROCEDURE

A. General:

1. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

2. Make air quantity measurements in ducts by Pitot-tube traverse of entire cross sectional area of duct.

3. Measure air quantities at air inlets and outlets.

4. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

5. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

6. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

7. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

8. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

9. Adjust outside air, return air, and exhaust dampers for design conditions.

10. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

11. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

12. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

13. For variable air volume system powered units, set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

14. On fan powered VAV boxes, adjust air flow switches for proper operation.

B. Specific:

1. The TAB Company shall perform the following TAB procedures in accordance with the following:

For Supply Fans:
a. Fan Speeds - Test and adjust fan RPM to achieve maximum or design CFM.
b. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
c. Pitot-Tube Traverse - Perform a Pitot-tube traverse of main supply and return ducts, as applicable to obtain total CFM.
d. Outside Air - Test and adjust the outside air on applicable equipment using a Pitot-tube traverse. If a traverse is not practical, use the mixed-air temperature method if the inside and outside temperature difference is at least 20 degrees F., or use the difference between Pitot-tube traverses of the supply and return air ducts.
e. Static Pressure - Test and record system static profile of each supply fan.

For Exhaust Fans:
a. Fan Speeds - Test and adjust fan RPM to achieve maximum or design CFM.
b. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
c. Pitot-Tube Traverse - Perform a Pitot-tube traverse of main exhaust ducts to obtain total CFM.
e. Static Pressure - Test and record system static profile of each exhaust fan.

For Zone, Branch and Main Ducts:
a. Adjust ducts to within design CFM requirements. As applicable, at least one zone balancing damper shall be completely open. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.

For Diffusers, Registers, and Grilles:
a. Tolerances - Test, adjust, and balance each diffuser, grille, and register to within 10% of design requirements. Minimize drafts.
b. Identification - Identify the type, location, and size of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.

For Coils:
a. Air Temperature - Once air flows are set to acceptable limits, take differential pressure readings across coils and take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry bulb temperature shall be taken on the entering and leaving side of each heating coil.

3.07 WATER SYSTEM PROCEDURE

A. General:

1. Adjust water systems to provide required or design quantities.

2. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not

installed, base flow balance on temperature difference across various heat transfer elements in the system.

3. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

4. Affect system balance with automatic control valves fully open to heat transfer elements.

5. Affect adjustment of water distribution systems by means of balancing cocks, valves and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

6. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

B. Specific:

1. The TAB Company shall perform the following standards:

<u>For Pumps:</u>
a. Test and adjust chilled water and hot water pumps to achieve maximum or design GPM. Check pumps for proper operation. Pumps shall be free of vibration and cavitation. Record appropriate gauge readings for final TDH and Block-Off/Dead head calculations.
b. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.

<u>For System Mains and Branches:</u>
a. Adjust water flow in pipes to achieve maximum or design GPM.

<u>For Boilers:</u>
a. Verify that boilers have been filled and started by others, and are in operation.
b. Test and adjust water flow through water boilers.
d. Test and record temperature and pressure profiles of water or steam boilers.

<u>For Coils:</u>
a. Tolerances - Test, adjust, and balance all chilled water and hot water coils within 10% of design requirements.
b. Verification - Verify the type, location, final pressure drop and GPM of each coil. This information shall be recorded on coil data sheets.

END OF SECTION 23 05 93
TESTING, ADJUSTING and BALANCING

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SECTION 23 05 94

IAQ for OCCUPIED BUILDINGS UNDER CONSTRUCTION

PART 1 – GENERAL

1.01 SCOPE OF WORK

It is the intent of this specification to outline the need for a plan that maintains the quality of the building during the renovation and addition to the building.

1.02 RELATED SECTIONS

A. Section 23 00 00 - Mechanical General Provisions.

B. Section 23 05 00 - Basic Mechanical Materials and Methods.

C. General Construction Specifications.

1.03 REFERENCES, STANDARDS

G. The following is a list of standards that this work shall be performed and submitted in accordance with. It is the responsibility of this contractor to adhere to the more stringent specifications of these different standards to meet the requirements this section.

H. IAQ Guidelines for Occupied Buildings Under Construction, Sheet Metal and Air Conditioning Contractors' National Association, Inc., First Edition, 1995.

I. Good Practice Guidelines for Maintaining Acceptable Indoor Environmental Quality During Construction and Renovation Projects, National Institute for Occupational Safety and Health, 1997.

J. Mold Remediation in Schools and Commercial Buildings, United States Environmental Protection Agency, 2001.

1.04 INDOOR AIR QUALITY

Goals: The owner has set the following indoor air quality goals for jobsite operations on project, within the limits of the construction schedule, contract sum, and available materials, equipment, products and services. Goals include:

1. Schedule renovation work during periods of low building occupancy if possible.
2. Isolate work areas from occupied areas using critical barriers, air pressure control and high-efficiency particulate air (HEPA) filtration.
3. Minimize the number of building penetrations necessary for entry into the renovation area. Choose the penetration sites carefully to minimize the potential for occupant exposure.
4. Modify HVAC operations according to specifications of consulting and IUPUI staff engineers prior to and during renovation activities to ensure isolation of renovation areas from occupied spaces.
5. Maintain an adequate unoccupied buffer zone around renovation areas according to design specifications. This may require temporarily relocating building occupants in the immediate vicinity of renovation areas.
6. Increase housekeeping activities in adjacent occupied areas during

renovation activities that create dust.

1.04 INDOOR AIR QUALITY PLAN

A. Within fourteen (14) days after receipt of Notice of Award and prior to any waste removal by the Contractor from the Project, the Contractor shall develop and submit to the Owner for review a healthy indoor air quality plan. This plan shall be Part II of a "Sustainable Job Site Operations Plan."

1. List of IAQ protective measures to be instituted on the site.
2. Specify conditions that would require an emergency response, such as asbestos release or a major water loss.
3. Employ local exhaust when dust, hazardous vapors, fumes, or gases are generated. If local exhaust is not feasible, portable air cleaning devices (such as the use of HEPA-filtration) may be used.
4. Minimize dust generation by using wet methods for cutting or sanding.
5. Locate dumpsters for debris away from operating HVAC outdoor air intakes and exterior doors to occupied areas where possible

1.05 SUBSTITUTIONS

A. Should the Contractor desire to use procedures, materials, equipment, or products that are not specified but meet the intent of these specifications to protect air quality on the site, the Contractor shall propose these substitutions in accordance with Substitutions and "Or Equal" in General Requirements.

PART 2 - MATERIALS

2.01 GENERAL

A. Low emitting products have been specified in appropriate sections.

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor is minimally required to meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 1995 to:

1. Protect the ventilation system components from contamination, OR provide cleaning of the ventilation components exposed to contamination during construction prior to occupancy.
2. Provide a continuous ventilation rate of one air change per hour minimum during construction, OR, conduct a building flush-out with new filtration media at 100% outside air after construction ends (following issuance of Occupancy Certificate) and prior to occupancy for seven days (one week).
3. Provide a minimum of 85% filtration (as determined by ASHRAE Standard 52.1-1992) on any return air systems operational during construction, and replace filtration media prior to occupancy.
4. Ventilation shall be provided in order to maintain a negative pressure in all areas of occupied buildings where there is potential for dust contaminant generation from a construction project.

5. The contained area shall be kept under negative pressure relative to the surrounding areas by the use of HEPA filtered negative air machine(s). A minimum of -.02 column inches of water pressure differential, relative to outside pressure, shall be maintained within the work area as evidenced by manometer measurements provided by the contractor on a continuous basis.
6. Construction documents shall specify modifications required to existing mechanical systems or temporary equipment to be installed to properly ventilate the affected building areas.
7. Construction documents shall include temporary ductwork layouts (as necessary) as well as sizing and specifications of fans.
8. Contractors shall not make design decisions for temporary ventilation of occupied areas of buildings.
9. Isolate portions of the HVAC system that may become contaminated from renovation activities as specified by consulting and IUPUI staff engineers.
10. Seal return air grilles in renovation areas.
11. Upgrade filtration efficiency in the HVAC systems that continue to be used during renovation (if possible) as directed by specifications.

B. During installation of carpet, paints, furnishings, and other VOC-emitting products, provide supplemental (spot) ventilation for at least 72 hours after work is completed. Preferred HVAC system operation uses supply air fans and ducts only; exhaust provided through windows. Use exhaust fans to pull exhaust air from deep interior locations. Stair towers and other paths to exterior can be useful during this process.

C. Conduct regular inspection and maintenance of indoor air quality measures including ventilation system protection, and ventilation rate.

D. Require VOC-safe masks for workers installing VOC-emitting products (interior and exterior) defined as products that emit 150 gpl or more UNLESS local jurisdiction's requirements (Canadian or US) are stricter, in which case the strictest requirement shall be followed for use of VOC-safe masks.

E. Use low-toxic cleaning supplies for surfaces, equipment, and worker’s personal use. Options include several soybean-based solvents and cleaning options (SoySolv) and citrus-based cleaners.

F. Use wet sanding for gypsum board assemblies. Exception: Dry sanding allowed subject to owner approval of the following measures:
1. Full isolation of space under finishing
2. Plastic protection sheeting is installed to provide air sealing during the sanding
3. Closure of all air system devices and ductwork
4. Sequencing of construction precludes the possibility of contamination of other spaces with gypsum dust
5. Worker protection is provided

G. Use safety meetings, signage, and subcontractor agreements to communicate the goals of the indoor air quality construction plan.

3.02 HOUSE KEEPING MEASURES FOR AIR QUALITY ASSURANCE

A. Identify the route(s) for removing construction debris from the building.
B. Identify traffic routes for renovation workers within the building, using pathways away from occupied spaces if possible.

C. Identify specific locations within buildings that contractors may use, including restrooms (if appropriate).
D. Eliminate demolition/renovation debris by bagging on site and/or the use of covered wheelbarrows or cart to transport debris to containers outside of the building.
E. Contractors shall clean areas inside of construction exits to minimize dirt and debris from entering occupied spaces in the building.
F. Contractors shall clean occupied areas adjacent to renovation site (such as hallways) if construction debris or soil has caused an area to be notably dirtier than other similarly occupied areas.
G. Place walk-off mats at all entrances and exits from the renovation area. These mats must be regularly cleaned or replaced to minimize migration of dust from the project site.

3.03 SPECIFIC CONTROL MEASURES FOR PAINTING OCCUPIED AREAS

A. Schedule work during evening hours or periods of low building occupancy.

B. Use low odor/ low VOC products.

C. Provide EHS copies of Material Safety Data Sheets for all products being used.

D. Provide ventilation in the area. If necessary, maintain a negative pressure in all areas being painted.

3.04 ROOF LEAKS, PIPE BREAKS AND OTHER WATER LOSSES CAUSED BY RENOVATION

A. Contractors are responsible for all water losses inside buildings that happen as a result of their renovation activity.

B. Contractors shall inform Campus Facilities Services of all water losses that occur due to construction activities.

C. Campus Facilities Services will manage the water remediation process and be reimbursed by contractor for all expenses involved with the remediation.

D. Only University-approved contractors will be employed for water remediation.

E. Water must be removed and damaged building materials must be replaced.

3.05 OUTDOOR WORK WITH HAZARDOUS ODORUOUS MATERIAL NEAR INTAKES

A. Locate portable toilets away from air intakes.

B. Use or application of chemical/odorous materials shall be located at least 25 feet away from all outside air intakes (if feasible).

C. When work including chemical/odorous materials must be done at or near air intakes, outside air intake should be minimized or the task should be performed when the building is not occupied (such as evenings or weekends).

D. For long-term projects that use chemicals or produce combustion exhaust near air intakes, install charcoal filters in the air handling units serving the occupied space of the building.

3.06 MEASURES FOR GOOD AIR QUALITY

A. Discuss air quality issues at regularly-scheduled construction meetings. The contractor indoor air quality representative needs to be included in these meetings.

B. Monitor renovation activities carefully to ensure that all work conforms to the stated air quality control measures.

C. Monitor pressurization at renovation areas, using a pressure monitoring device, to ensure that proper isolation and ventilation is in effect.

D. Monitor for visible or odorous airborne contaminants in adjacent occupied areas.

E. Promptly respond to occupant complaints in order to resolve issues that involve renovation areas.

3.07 MEASURES FOR ENFORCEMENT OF AIR QUALITY ASSURANCE

A. Contractors are responsible for meeting all specifications involving maintaining acceptable air quality for building occupants.

B. Contractors shall coordinate with University Architects Office and Environmental Health and Safety for any variations to the specifications or circumstances outside of their control involving air quality in occupied buildings.

C. If an acceptable air quality condition is not maintained by contractors, appropriate University officials may halt construction operations until suitable measures have been taken to restore good air quality for building occupants.

END OF SECTION 23 05 94
IAQ for OCCUPIED BUILDINGS UNDER CONSTRUCTION

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SECTION 23 07 00

THERMAL INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Piping insulation, jackets and accessories.

B. Ductwork insulation, jackets and lining.

C. Equipment insulation and covering.

D. Breeching insulation.

1.02 RELATED WORK

A. Section 23 05 00 - BASIC MECHANICAL MATERIALS AND METHODS.

B. Section 23 25 00 - HYDRONIC PIPING

C. Section 23 31 00 - DUCTING

1.03 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with three years minimum experience.

B. Insulation materials shall be 100% asbestos free.

1.04 SUBMITTALS

A. Submit product data under provisions of Section 23 00 00.

B. Include product description, list of materials and thickness for each service or equipment scheduled, and locations. Provide manufacturer=s installation instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Owens Corning, Manville, Armstrong, Certain Teed, Knauf or substitutions under provisions of Section 23 00 00

2.02 MATERIALS

A. Type A: Fiberglass pipe insulation equal to Owens Corning Fiberglass ASJ/SSL-II Pipe Insulation with a "k" value of 0.25 @ 75 F, ASTM C547, Class 1, including vapor barrier.

Vapor Retarder Jacket: White kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or jacket with outward clinch expanding staples coated with vapor barrier mastic as needed.

B. Type B: Closed-Cell, Elastomeric foam rubber insulation equal to Armstrong AP Armaflex. (Pipe and/or sheet insulation in accordance with ASTM C-534; with a AK@ value not to exceed .27 @ 75 F), max flame spread 25, max smoke developed 50.

C. Type C: Rigid board duct, class 1, insulation equal to Owens Corning type 703 with a maximum thermal conductivity of .22 @ 75 F, and FRK vapor barrier facing, ASTM C612, Class 1.

D. Type D: Flexible duct insulation equal to Owens Corning all service duct wrap type 100 with a maximum thermal conductivity of .27 @ 75 F, and FRK vapor barrier facing ASTM C553, Type 1, Class B-4.

E. Type E: Acoustical duct liner equal to Owens Corning Aeroflex duct liner type 150 with a maximum thermal conductivity of .28 @ 75 F. Ductwork dimensions indicated are inside dimensions required for air flow. For applications involving indoor air quality concerns, use Armstrong=s self-adhering, non-fibrous, Armaflex duct liner (3/4" thick).

F. Type F: Rigid foam glass with Pit wrap.
- 1-1/2" thickness up to 2" pipe dia.
- 2" thickness above 2" pipe dia.

G.. Type G: Semi-rigid fiberglass board insulation, factory jacketed with a laminated Kraft aluminum foil All Service Jacket (ASJ) vapor barrier. Maximum thermal conductivity of 0.27 @ 75° F. Insulation shall be equal to Owens Corning pipe and tank insulation.

H. Field Applied Jackets

1. PVC Plastic: One piece molded type fitting covers and jacketing material, gloss white.
   a. Connections: Tacks, pressure sensitive color matching vinyl tape.

2. Canvas Jacket: UL Listed fabric, 6 oz./sq. yd., plain weave cotton treated with dilute fire retardant lagging adhesive.

3. Aluminum Jacket: 0.016 inch thick sheet finish, with longitudinal slip joints and 2 inch laps, die shaped fitting covers with factory applied moisture barrier.

4. Stainless Steel Jacket: Type 304 stainless steel, 0.010 inch.

I. Hydrous Calcium Silicate meeting ASTM C 533, Type I; rigid molded pipe; asbestos-free color coded throughout material thickness.

1. >K= Value: 0.42 at 300 ° F Mean Temperature as tested in accordance with ASTM C 335.

2. Maximum Service Temperature: 1200 ° F.

3. Non-combustible as determined by test following ASTM E 136.

4. Tie Wire: 16 gage stainless steel with twisted ends on maximum 12 inch centers.

PART 3 - EXECUTION

3.01 PREPARATION

A. Install materials after piping or ductwork has been tested and approved. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's instructions, building codes and industry standards.

B. Continue insulation with vapor barrier through penetrations.

C. Exterior insulated piping shall be jacketed with .016" aluminum jacket, banded on 18" centers and sealed watertight with mastic. Sealing not required if Type B insulation (elastomeric foam) is installed per manufacturer=s instructions (entire insulation system is air/water tight, vapor barrier).

D. All fittings and valves shall be insulated with corresponding pipe insulation. Domestic hot water line valves, mechanized fittings and joints (i.e., unions, etc.) may be uninsulated if they are concealed in walls or above ceilings.

E. Unions and flanges on insulated cold water piping shall be insulated, but on other systems shall not be insulated. Terminate insulation neatly at each side of union and/or flange with insulating cement, so unions and flanges may be taken apart without disturbing insulation.

F. Rigid board insulation shall be impaled over Mechanical fasteners, (SMACNA fastener standard), on 12 in. x 18 in. centers. Use a minimum of two rows of fasteners per side.

G. Flexible insulation shall be firmly adhered to ducts with full coverage of fire retardant adhesive. For flexible insulation on ducts 24 inches or more in width, use both adhesive and mechanical fasteners on the bottom of the duct to prevent possible sagging. Mechanical fasteners and spacing shall be as specified for rigid board insulation.

H. Acoustical duct liner shall be adhered to the sheet metal with 100% coverage of adhesive, and all exposed leading edges and all transverse joints coated with adhesive. Duct liner shall also be secured using mechanical fasteners which shall compress the liner sufficiently to hold it firmly in place.

I. Cover exterior insulated rectangular ducts with .016" thick aluminum jacket secured watertight with mechanical fasteners, bands or screws.

J. Cover exterior insulated round ducts with .016" thick aluminum jacket with moisture barrier.

3.03 INSULATION SCHEDULE

	SERVICE	SIZE	INSULATION TYPE & THICKNESS
	HEATING HOT WATER	UP THRU 1-1/2"	TYPE A, 1" or TYPE B, 3/4"
	HEATING HOT WATER	OVER 1-1/2"	TYPE A, 1-1/2" or TYPE B, 1"
	HEAT PUMP PIPING	UP THRU 1-1/2"	TYPE A, 1" or TYPE B, 3/4"
	HEAT PUMP PIPING	OVER 1-1/2"	TYPE A, 1-1/2" or TYPE B, 1"
	DOMESTIC HOT WATER	UP THRU 1-1/2"	TYPE A, 1" or TYPE B, 1/2"
	DOMESTIC HOT WATER	OVER 1-1/2"	TYPE A, 1-1/2" or TYPE B, 3/4"
	DOMESTIC COLD WATER	ALL SIZES	TYPE A, 1" or TYPE B, 1/2"
	STORM	ALL SIZES	TYPE A, 1" or TYPE B, 1/2"
	ROOF DRAINS	ALL SIZES	TYPE A, 1" or TYPE B, 1/2"
	REFRIG. LINES	THRU 4"	TYPE B, LINE TEMP +10EF or LOWER - 1"; LINE TEMP +10EF or HIGHER - 3/4"
	CONDENSATE PIPING	ALL SIZES	TYPE A, 1" OR TYPE B, 3/4"
	ALL ROUND OUTSIDE AIR (MAKE-UP & COMBUSTION) & RELIEF AIR DUCTS	ALL SIZES	TYPE D, 2" or TYPE B, 3/4"
	ALL RECTANGULAR OUTSIDE AIR (MAKE-UP & COMBUSTION) & RELIEF AIR DUCTS	ALL SIZES	TYPE C, 1-1/2" or TYPE B, 3/4"
	EXHAUST AIR DUCTS WITHIN 10' OF OUTSIDE TERMINATION	ALL SIZES	TYPE D, 2", or TYPE B, 3/4"
*	SUPPLY AIR DUCTS	ALL SIZES	TYPE D, 2", or TYPE B, 3/4"
	ACOUSTICALLY LINED ROUND DUCTS		SEE SPECIFICATION SECTION 15890 OR
	SUPPLY AND RETURN AIR DUCTS (ASSOCIATED WITH HEATING/COOLING EQUIP.) WITHIN 10' OF MECHANICAL EQUIPMENT OR AS SHOWN ON PLANS	ALL SIZES	TYPE E, 1", OR TYPE B, 3/4" (Armstrong=s self-adhering, non-fibrous, Armaflex duct liner)
	ALL DUCTWORK EXPOSED TO OUTDOOR AIR TEMPERATURES (i.e. ATTIC OR SOFFIT INSTALLATIONS)	ALL SIZES	TYPE D, 2" or Type B, 11/2"

SERVICE	**SIZE**	**INSULATION TYPE & THICKNESS**
ALL DUCTWORK EXPOSED TO OUTDOOR AIR TEMPERATURES (i.e. ROOF MOUNTED INSTALLATIONS)	ALL SIZES	TYPE B, 11/2", Reference 3.02.I for covering
EXHAUST DUCTWORK 10' LENGTH AHEAD OF FAN (UPSTREAM)		TYPE E, 1" OR TYPE B, 3/4" (Armstrong=s self-adhering,
SPIRAL DUCTWORK TO		DOUBLE WALLED
10' FROM UNIT DISCHARGE	ALL SIZES	PERORATED EQUAL TO UNITED MCGILL ACOUSTI-K27
WATER STORAGE TANKS & THERMAL BUFFER TANKS	ALL SIZES	TYPE G, 2" THICK

*** Round spiral exposed ducts are not required to be insulated. Acoustical lining or double wall (perforated) spiral ducting shall be required the first 10 feet from the unit.**

END OF SECTION 23 07 00
THERMAL INSULATION

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SECTION 23 21 13

HYDRONIC PIPING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Pipe and pipe fittings.

B. Valves.

C. Heating water piping system.

D. Heat Pump piping system.

1.02 RELATED WORK

A. Section 230500 - Basic Mechanical Materials and Methods

B. Section 230700 - Thermal Insulation

1.03 REGULATORY REQUIREMENTS

A. Conform to the latest revision of ANSI/ASME B31.9.

B. Boiler external piping shall comply with the latest revision of Section I of the ASME Boiler & Pressure Vessel Code.

1.04 SUBMITTALS

A. Submit product data under provisions of Section 230000. Include data on pipe materials, pipe fittings, valves, and accessories.

B. Submit a copy of the standard welding procedure specification together with the procedure qualification record as required by Section IX of the ASME B & PV Code.

C. Include welders certification of compliance with ANSI/ASME SEC 9.

PART 2 PRODUCTS

2.01 HEATING WATER PIPING

ITEM	TYPE JOINT	SIZE	CLASS	MATERIAL
TUBING	95-5 TIN Antimony	UP THRU 2"	TYPE L	ASTM B88/HARD DRAWN
FITTINGS	95-5 TIN Antimony	UP THRU 2"	TYPE L	ANSI B16.29 WROUGHT COPPER
UNIONS		UP THRU 2"	300 LB.	BRONZE TO BRONZE SEAT
PIPE	WELD	2 1/2" & UP	SCH.40	ASTM A53/SEAMLESS
FITTINGS	WELD	2 1/2" & UP	STANDARD	ASTM A234/ANSI B16.9
FLANGES		2 1/2" & UP	150 LB.	ANSI B16.5

2.02 GROOVED PIPING: Heating.

A. **Pipe:** Schedule 10 ASTM A-120 with factory supplied roll grooves that meet grooved coupling manufacturer's latest specification. All field roll grooves must be measured with a pi-tape and meet specification prior to coupling assembly. **Note:** This assembly method is important and joints will be randomly field checked by the engineer.

B. **Gaskets:** Gaskets must be Grade "E" with a Flushseal center leg design as provided by Victaulic Company of America or engineer approved equal. All product submittals must be approved prior to bidding. All gaskets must be lubricated with a non-petroleum based lubricant compatible with the grooved coupling manufacturer's gasket. Approved grooved coupling manufacturers: **Victaulic only**.

C. **Fittings:** All grooved fittings must be domestic and of one manufacturer. All grooved fittings must be manufactured of ASTM A-536 Ductile Iron. Approved grooved fittings manufacturers are **Victaulic Company of America**.

D. **Couplings:** All grooved couplings must be domestic and of one manufacturer. All couplings shall be Zero-Flex "rigid" design. All couplings must be installed as per the manufacturer's latest recommendations. Provide all necessary anchors, supports and restraints per the manufacturer's recommendations for all grooved pipe systems. Three (3) flexible grooved Style 77 or 75 couplings may be used at all pumps in lieu of flex connectors.

E. **Grooved Valves:**

1. All grooved butterfly and check valves must be of one domestic manufacturer and shall be rated to 300 PSI. All grooved valves shall have an internal and external PPS coating and the disc liner must be consistent with that of the grooved coupling gasket and be compatible for the service. All grooved butterfly valves must have a blowout proof stem. The disc and stem must be of a one piece ductile iron construction.

2. Butterfly Valves 2" - 6" must have a 10 position lever lock handle and valves above 6" must have a gear operator.

3. Tour & Anderson circuit balancing valves series 787 threaded, series 786 solder end & 789 grooved end arc are approved for heating services.

F. **Straining Devices:** Victaulic S/730 Tee strainer & 731 Suction Diffuser are approved for heating services.

2.03 POLYETHELENE TUBING:(Geothermal Earth Field)

Does not apply to this project.

2.04 GATE VALVES

A. Crane, Stockham, Powell, Conbraco or substitutions under provisions of Section 230000.

B. Up to 2 Inches: Bronze body, bronze trim and wedge, rising stem, and threaded ends.

C. Over 2 Inches: Cast iron body, bronze trim, rising stem, O.S. & Y., and flanged ends.

2.05 GLOBE VALVES

A. Crane, Stockham, Powell, Conbraco or substitutions under provisions of Section 230000.

B. Up to 2 Inches: Bronze body and disc, rising stem and handwheel, renewable composition disc, repackable under pressure and screwed ends.

C. Over 2 Inches: Cast iron body, bronze trim, rising stem, handwheel, O.S. & Y., plug-type disc, flanged ends, renewable seat and disc.

2.06 BALL VALVES

A. Crane, Stockham, Apollo or substitutions under provisions of Section 230000.

B. Up to 2 Inches: Bronze body, stainless steel ball, Teflon seats, and stuffing box ring and threaded ends.

2.07 BUTTERFLY VALVES

A. Crane, Stockham, Conbraco or substitutions under provisions of Section 230000.

B. Iron body, bronze disc, resilient replaceable seat for service to 250 degrees F, wafer or lug ends, extended neck, 10 position lever handle.

2.08 SWING CHECK VALVES

A. Crane, Stockham, Conbraco or substitutions under provisions of Section 230000.

B. Up to 2 inches: Bronze 45 degree swing disc, solder ends.

C. Over 2 inches: Iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.

2.09 SPRING LOADED CHECK VALVES

A. Crane, Stockham, Conbraco or substitutions under provisions of Section 230000.

B. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer or flanged ends.

2.10 RELIEF VALVES

A. Crane, Stockham, Conbraco or substitutions under provisions of Section 230000.

B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 EXECUTION

3.01 PREPARATION

A. Before proceeding with fabrication / installation of piping, inspect the contract documents and determine that the location of work does not interfere with other work. In case of interference, notify the Engineer.

3.02 INSTALLATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe. Remove scale and dirt on inside and outside before assembly. Prepare piping connections to equipment with flanges or unions.

B. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient. Group piping whenever practical at common elevations. Install valves with stems upright or horizontal, not inverted.

C. Install piping to conserve building space, and not interfere with use of space and other work.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

E. Provide clearance for installation of insulation, and access to valves and fittings. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with other trades.

F. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Prepare pipe, fittings, supports, and accessories for finish painting.

3.03 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Provide 3/4 inch ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

F. Use butterfly valves in heating, water systems interchangeably with gate and globe valves.

G. Use only butterfly valves in chilled water systems for throttling and isolation service.

END OF SECTION 23 21 13
HYDRONIC PIPING

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SECTION 23 25 00

CHEMICAL (WATER) TREATMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cleaning of piping systems.

B. Chemical feeder equipment.

C. Hydronic Heating Water Treatment System.

D. Glycol Heat Loops.

1.02 RELATED SECTIONS

A. Section 23 00 00 - Mechanical General Provisions

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 00 00.

B. Submit shop drawings and product data for manufactured products and assemblies required for this project.

C. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model. and dimensions.

D. Submit inspection certificates for pressure vessels from authority having jurisdiction.

E. Submit manufacturer's installation instructions under provisions of Section 23 00 00.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 23 00 00.

B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for delivery to public sewage systems.

PART 2 - PRODUCTS (Provided Under Part 3)

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

3.02 HYDRONIC WATER TREATMENT SYSTEM (Heating system)

A. General: Provide chemical cleaning for entire hydronic system. Provide all necessary mechanical equipment, chemicals, control equipment and service. All systems are provided or based on Enerco Corporation, 317 N. Bridge St., Grand Ledge, MI 48837, 800-292-5908.

B. Pre-Cleaning: Thoroughly flush all piping with fresh water. Remove and clean all strainers, open drip legs or other non-flow piping to remove debris.

Determine loop capacity in gallons by carefully filling the loop from completely drained dry to full with air bled out. Loop capacity to be taken from water meter readings. Submit written report of loop capacity to water treatment subcontractor and owner.

Refill system with fresh water along with alkaline detergent cleaner at recommended use rates. Circulate 8 - 72 hours. Flush system, open, clean and inspect all strainers, drip legs and non-flow areas. Refill with fresh water, establish bleed, and allow system to makeup fresh water and bleed until water leaving system is of same quality as makeup. Immediately introduce corrosion inhibitor to protect the clean system until normal start up.

END OF SECTION 23 25 00
CHEMICAL (WATER) TREATMENT

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SECTION 23 31 00

DUCTING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Low pressure ducts.

B. Duct cleaning.

1.02 RELATED WORK

A. Section 23 05 29 - Supports and Anchors: Sleeves.

B. Section 23 07 00 - Thermal Insulation.

C. Section 23 05 93 - Testing, Adjusting and Balancing.

1.03 REFERENCES

A. ASHRAE - Handbook 1989 Fundamentals; Duct Design.

B. ASHRAE - Handbook 1988 Equipment; Duct Construction.

C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

E. SMACNA - Low Pressure Duct Construction Standards.

F. SMACNA - High Pressure Duct Construction Standards.

G. UL 181 - Factory-Made Air Ducts and Connectors.

H. Fibrous glass duct construction standards.

1.04 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Three pressure classifications: 1/2 inch WG positive or negative static pressure and velocities less than 2,000 fpm; 1 inch WG positive or negative static pressure and velocities less than 2,500 fpm and 2 inch WG positive or negative static pressure and velocities less than 2,500 fpm.

1.05 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 (if applicable) standards.

1.06 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 230000.

B. Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work for low and medium pressure and kitchen hood exhaust systems.

C. Submit manufacturer's installation instructions for glass fiber ducts under provisions of Section 23 00 00.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.

B. Steel Rectangular Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per square feet for each side in conformance with ASTM A90.

C. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.

D. Round Spiral Ducts: ASTM A-527-71, galvanized steel, spiral locking seam equal to United McGill Uni-Seal.

E. Internal Insulated Round Spiral Ducts: ASTM A-527-71, galvanized steel, spiral locking seam equal to United McGill Uni-Rib k-27.

F. Fibrous Glass Ducts: UL 181; 1-1/2 inch thick rigid glass fiber with aluminum foil, glass scrim and kraft or plastic jacket vapor barrier; maximum 0.23 K value at 75 degrees F.

G. Stainless Steel Ducts: ASTM A167, type 304.

2.02 LOW PRESSURE DUCTWORK

A. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

E. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.

F. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

H. Use double nuts and lock washers on threaded rod supports.

PART 3 - EXECUTION

3.01 PREPARATION/INSTALLATION

A. Before proceeding with fabrication and installation of ductwork, inspect the contract documents and determine that the location of work does not interfere with other work. In case of interference, notify the Engineer.

B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. Connect diffusers or troffer boots to low pressure ducts with 5 feet maximum length of flexible duct in areas where a ceiling is installed. Hold in place with strap or clamp.

E. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

F. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out. Use stainless steel for all ductwork. Ductwork installation is to meet Michigan Health Department Regulations.

3.02 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM	MATERIAL
Low Pressure Supply	Rectangular or spiral round as indicated on drawings.
Return and Relief	Rectangular or spiral round as indicated on drawings.
Toilet Exhaust	Galvanized Steel
Outside Air Intake	Galvanized Steel
Combustion Air	Galvanized Steel
Acoustically Lined Supply	Internally insulated as indicated.

3.03 ADJUSTING AND CLEANING (Only required if contractor fails to keep clean.)

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

B. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION 23 31 00
DUCTING

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SECTION 23 41 00

AIR FILTERS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Filters.

B. Spare Media & Filters.

1.02 RELATED WORK

A. Section 23 00 00 – MECHANICAL GENERAL PROVISIONS

1.03 QUALITY ASSURANCE

A. Unless otherwise specified, all filter efficiencies shall be based on the ASHRAE Standard 52-76 test on atmospheric dust.

B. Filter unit and media shall be fabricated from basic raw materials by the same manufacturer.

1.04 INDOOR AIR QUALITY ASSURANCE

A. The filtration requirements shall be as specified and shown on the plans and shall be in strict accordance with ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality.

B. The successful bidder shall include with their submittals documentation that the equipment submitted will meet or exceed the design requirements in these specifications and ASHRAE 62-1989.

C. Documentation shall include, but not limited to, mathematical calculations that demonstrate the filtration devises submitted will meet the requirements of ASHRAE 62-1989's method of designing for acceptable indoor air quality.

D. Documentation shall include allowances for ventilation effectiveness, outdoor air quality, minimum ventilation rate during occupancy, and the systems affect on respirable particulate and targeted volatile organic compounds.

E. The particulate and gas phase filtration system specified is in strict compliance with ASHRAE standard 62-1989. Any deviation from the basis of design must be submitted along with all above listed documentation two weeks prior to bid date.

F. The successful bidder shall include in their submittals, the manufacturer's signed letter of assurance of equipment conformance with ASHRAE standard 62-1989 as related to performance.

1.05 SUBMITTALS

A. Shop Drawings and Product Data:

1. Refer to Section 23 00 00 - Mechanical General Provisions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The air filter design has been based on Farr filters.

2.02 MIXING BOX & FLAT FILTERS

A. Air Filters shall be medium efficiency, pleated, disposable type. Each filter shall consist of a cotton and synthetic fabric media, media support grid, and enclosing frame. The filter shall be listed as Underwriters' Laboratories Class 1.

B. 2” and 4" Depth as required:

The Filter shall have no less than 4.6 square feet of media per square foot of filter face area and no less than 15 pleats per linear foot of filter face area. A 96% open area media support grid of 25 gauge welded wire construction, coated with rust inhibitor, shall be bonded to the air exiting side of the filter. The enclosing frame shall be high wet-strength beverage board with diagonal support members bonded to the air entering and air exiting side of each pleat. The inside periphery of the enclosing frame shall be bonded to the filter pack.

C. The Filter shall have an average efficiency of 25-30%, and an average arrestance of 90.2% in accordance with ASHRAE Standard 52.1-1992. The minimum MERV when tested under ASHRAE 52.2 shall be no less than 8. Initial resistance at 500 feet per minute approach velocity shall not exceed 0.30".

D. Filters for FLC (fluid cooler) to be equal to Fiberbond Dust Lock cube. As manufactured with moisture resistant material.

E. Filters are based on Farr.

F. Supply filters for all air moving equipment per manufacturer’s recommendation.

PART 3 - EXECUTION

3.01 SPARE MEDIA AND FILTERS

A. In the original installation of filters, provide filter media. On completion of the work, furnish and deliver to the Owner, spare media and filters equal to the complete replacement of the mixing box and flat filters provided in the original installation.

1. Filter unit and media shall be fabricated from basic raw materials by the same manufacturer.

2. Each media carton to bear a code number certifying that the following tests have been carried out by the manufacturer: ASHRAE Standards Test 52-68, AFI Performance Test, Test for Uniformity of Resistance, Media Compressibility and Strength Test, Weight Test for Quantity of Fiber. Laboratory proof of performance will be required.

3.02 INDOOR AIR QUALITY(IAQ) MANAGEMENT PLAN FOR CONSTRUCTION AND PRE-OCCUPANCY

A. If the air handling units are used during construction, filtration media with a minimum Efficiency Reporting Value (MERV) of 13 must be used at each return air grille, as determined by ASHRAE 52.2-1999.

B. During construction procedures must meet or exceed the recommended Design Approaches of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3.

C. Protect stored on-site or installed absorptive materials from moisture damage.

D. Replace all Filtration media immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13, as determined by ASHRAE 52.2.-1999 for media installed at the end of construction.

E. If the air handling units are not used during construction all terminations (SA, RA, and EA) shall be covered as to not allow contaminates from entering.

END OF SECTION 23 41 00
AIR FILTERS

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SECTION 23 52 16

PACKAGED BOILER

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services as required for the complete installation designed in the Contract Documents.

1.2 SUBMITTALS

A. Boilers-burners, auxiliaries and accessories.

B. The boilers shall be a Vitodens 200-W-105, and shall be operated on Natural Gas.

C. The boilers shall be capable of full modulation firing down to 20% of rated input with a turndown ratio of 5:1.

1.3 CERTIFICATIONS AND CODE COMPLIANCE

A. Boiler and boiler installation shall comply with all state and local code requirements. Contractor shall obtain certificate of boiler inspection after boiler installation has been completed and pay all fees associated with such inspection.

B. The boiler(s) shall be designed certified and castings shall bear the ASME “H” stamp and be national board listed.

C. The boiler shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard for the U.S. and Canada.

D. The boiler shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard and the minimum efficiency requirements of the latest edition of the ASHRAE 103 Standard.

E. The boiler shall operate at a minimum of 93% thermal efficiency. The boiler shall be certified for indoor installation.

F. Contractor shall install code required emergency shut down.

1.4 GENERAL

A. The following boiler-burner control features provided on all units:

1. Primary combustion controls shall operate on 120 volts, single phase, grounded circuit.

2. Control wiring in conduit separate from power wiring conduit.

3. Wiring in accordance with National Electric Code.

PART 2 PRODUCTS

2.1 GENERAL

A. The boiler shall include a single compact heat exchanger made of high-alloy stainless steel, designed based on the laminar heat transfer principle for high operational reliability and a long service life. A radial design shall be used to obtain maximum heat transfer performance in a single pass. Rectangular design of the coil is required to maximize the coil gap length and ensure maximum utilization of the heat exchanger surface. Defined gaps (0.8 mm) between coil passes and a heat exchanger length of 53 mm shall be sized to promote laminar flue gas flow for efficient heat transfer. The heat exchanger design shall allow for self-cleaning functionality.

B. The burner shall be constructed from high-grade stainless steel for universal use with natural gas or propane gas. Burner ignition shall be by a direct spark ignition system. The boiler shall be equipped with a digital boiler control unit interface.

C. The burner shall be capable of operating at altitude of up to 10,000 ft. (3,000 m) without change of orifices, but with the use of an electronic coding card.

D. Wire and cable entry to boiler shall be facilitated by strain reliefs to protect electrical wires. All controls, relays, transformers, ignition module, wiring, and redundant seat combination gas valve shall be installed behind the boiler enclosure.

E. The boiler shall be equipped with a flue gas vent opening at the top of the boiler. Venting shall be side wall horizontal or vertical sealed (direct vent) chimney system. The boiler shall operate under Category IV positive vent pressure conditions for room air dependant operation. Venting material for room air dependant operation shall be stainless steel UL approved venting system for positive pressure or CPVC ULC S636 listed material.

F. The boiler shall be rated for zero (0") clearance to combustibles, including its vent system.

G. Standard equipment shall also include the following items:

1. Manual reset fixed high limit set at 210℉ (99℃), wired in series with ignition system.
2. Integrated control.
3. 30 or 45 psig pressure relief valve; 60 psig relief valve available.
4. Temperature and pressure gage and pipe fittings.

2.2 BOILER CONTROLS

A. The boiler shall utilize a 24 VAC control circuit and components. The control system shall have an electronic display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket.

B. The boiler shall be equipped with an outdoor air reset function. The manufacturer shall verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping.

C. The control shall communicate a modulating boiler temperature set point to the individual boilers, and shall be weather responsive reset-based. The control shall be able to communicate with up to four (4) boilers. The control shall have the ability to communicate to mixing valve controls, and shall allow for a single outdoor temperature sensor to be used and communicated to mixing valve controls. The control shall use an infinitely adjustable heating curve to calculate supply temperature. To assist in the calculation of supply temperature, the control shall allow for the selection of building construction. The control shall be capable of managing DHW production. The control shall be able to accept a 0-10VDC signal from an external resistive module.

2.3 VENTING

A. The boiler shall be equipped with a flue gas vent opening at the top of the boiler. Venting shall be side wall horizontal or vertical sealed (direct vent) chimney system. The boiler shall operate under Category IV positive vent pressure conditions for room air dependant operation. Venting material for room air dependant operation shall be stainless steel UL approved venting system for positive pressure or CPVC ULC S636 listed material. ***Foam Core pipe is not an approved material for exhaust piping.***

B. The boiler shall have an independent laboratory rating for Oxides of Nitrogen (NO_x) of 30 ppm or less corrected to 3% O_2.

C. The boiler shall be rated for zero (0") clearance to combustibles, including its vent system.

D. Standard equipment shall also include the following items:

1. Manual reset fixed high limit set at 210℉ (99℃), wired in series with ignition system.
2. Integrated control.
3. 30 or 45 psig pressure relief valve; 60 psig relief valve available.
4. Temperature and pressure gage and pipe fittings.

PART 3 EXECUTION

3.1 WARRANTY

A. Provide a one (1) year limited warranty on the parts.

B. Provide a ten (10) year limited warranty on the castings against corrosion.

C. Service and Guarantees

1. Arrange for boiler manufacturer to provide:

    a. Instructions for proper installation and operation of boilers, burners and controls supplied by a "factory certified" technician directly employed by the manufacturer's representative.

    b. Checking proper size of gas piping.

c. Supplying motors, starters, and control wiring in compliance with requirements of “Motors and Electric Wiring Sections and National Electric Code.

d. Supplying required correct wiring diagrams, indicating wiring to remotely located equipment connected with boiler-burner operation.

e. Provide free inspection, adjustment and 24 hour emergency service within one (1) year guarantee period.

END OF SECTION 23 52 16
PACKAGED BOILER

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SECTION 23 83 16

RADIANT-HEATING HYDRONIC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Radiant floor heating systems for various floor constructions and control strategies, using crosslinked polyethylene (PEX) tubing and applicable fittings.

1.02 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established RADIANT-HEATING HYDRONIC PIPING 23 83 16 © 2006 Uponor, Inc. Radiant Floor Heating Specification (PEX Tubing) — Dec. 1, 2006
by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. ASTM International

1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials

3. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops

4. ASTM F876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing

5. ASTM F877 Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems

6. ASTM F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing

C. American National Standards Institute (ANSI)/Underwriters Laboratories, Inc. (UL)

1. ANSI/UL 263 Standard for Safety for Fire Tests of Building Construction and Materials

D. International Code Council (ICC)

1. International Mechanical Code (IMC)

2. International Building Code (IBC)

3. ICC Evaluation Service (ES) Evaluation Report No. ESR 1099

E. Plastics Pipe Institute (PPI)

1. Technical Report TR-3 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials

2. Technical Report TR-4 Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Piping and Fitting Compounds

F. International Association of Plumbing and Mechanical Officials (IAPMO)

1. Uniform Mechanical Code

G. Uponor

1. Complete Design Assistance Manual (CDAM), 5th edition

2. Radiant Floor Installation Handbook, 6th edition

3. Uponor System Design Software (USDS) or Advanced Design Suite™ (ADS) Software

1.03 SYSTEM DESCRIPTION

A. Design Requirements

1. Standard Grade hydrostatic pressure ratings from Plastics Pipe Institute in accordance with TR-3 as listed in TR-4. The following three standard-grade hydrostatic ratings are required.

a. 200 degrees F (93 degrees C) at 80 psi (551 kPa)

b. 180 degrees F (82 degrees C) at 100 psi (689 kPa)

c. 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa)

2. Certification of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 for the following PEX tubing sizes when encased with ½ inch fiberglass insulation at tube spacing of not less than 4 inches apart.

a. 5/16 inch [7.94mm]

b. ⅜ inch [9.53mm]

c. ½ inch [12.7mm]

d. ⅝ inch [15.88mm]

e. ¾ inch [19.05mm]

f. 1 inch [25.4mm]

g. 1 ¼ inch [31.75mm]

h. 1 ½ inch [38.1mm]

i. 2 inch [50.8mm]

B. Performance Requirements: Provide hydronic radiant floor heating system that is manufactured, fabricated and installed to comply with regulatory agencies and authorities with jurisdiction, and maintain performance criteria stated by the PEX tubing manufacturer without defects, damage or failure.

1. Show compliance with ASTM F877.

2. Show compliance with DIN 4726 regarding oxygen diffusion concerns where applicable.

3. Show compliance with ASTM E119 and ANSI/UL 263 through certification listings with Underwriters Laboratories, Inc. (UL).

a. UL Design No. L557 — 1 hour wood frame floor/ceiling assemblies

b. UL Design No. K913 — 2 hour concrete floor/ceiling assemblies

c. UL Design No. U372 — 1 hour wood stud/gypsum wallboard wall assemblies

d. UL Design No. V444 — 1 hour steel stud/gypsum wallboard wall assemblies

1.04 SUBMITTALS

A. Product Data: Provide for manufactured products and assemblies, including installation recommendations and rough-in dimensions.

B. Operating and Maintenance Instructions: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts description.

1.05 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.

1. Warranty covers the repair or replacement of any tubing or fittings proven defective.

2. Warranty may transfer to subsequent owners.

3. Warranty Period for PEX Tubing: 30-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion when installed by a factory-trained Uponor Home Comfort Team (HCT) contractor.

4. Warranty Period for Manifolds and Fittings: 5-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion when installed by a factory-trained Uponor HCT contractor.

5. Warranty Period for Controls and Electrical Components: 2-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion when installed by a factory-trained Uponor HCT contractor.

6. If a factory-trained Uponor HCT contractor does not install the system, then the most recent limited warranty published by the PEX tubing manufacturer takes precedence.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion of radiant floor heating training by the PEX tubing manufacturer.

B. Regulatory Requirements and Approvals: Provide a radiant floor heating system that complies with the following requirements.

1. International Code Council (ICC)

a. International Mechanical Code (IMC)

b. International Building Code (IBC)

c. ICC Evaluation Service (ES) Evaluation Report No. ESR 1099

2. International Association of Plumbing and Mechanical Officials (IAPMO)

a. Uniform Mechanical Code (UMC)

C. Certifications: Provide letters of certification as follows.

1. Installer is trained by the PEX tubing manufacturer to install the radiant floor heating system.

2. Installer uses skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed tradesperson.

D. Pre-installation Meetings

1. Verify project requirements, substrate conditions, floor coverings, manufacturer's installation instructions and warranty requirements

2. Review project construction timeline to ensure compliance or discuss modifications as required

3. Interface with other trade representatives to verify areas of responsibility

4. Establish the frequency and construction phrase the project engineer intends for site visits and inspections by the PEX tubing manufacturer's representative

1.07 DELIVERY AND STORAGE HANDLING

A. General Requirements: Materials shall be delivered in their original, unopened packages, and protected from exposure to the elements. Damaged or deteriorated materials shall be removed from the premises.

PART 2 - PRODUCTS

2.01 HYDRONIC RADIANT FLOOR HEATING SYSTEM

A. Manufacturer: Uponor, Inc.

2.02 PRODUCT SUBSTITUTIONS

A. All products, components, etc., specified herein are manufactured by and/or available from the PEX tubing manufacturer.

B. Alternative equipment manufacturers must submit required data for all electrical, mechanical, structural, engineering, etc. revisions for an equivalent system for approval 15 days prior to bid.

C. Alternative equipment manufacturers must submit completed radiant floor design layout to the project engineer for approval. Plagiarism of another manufacturer's design is unacceptable.

2.03 HYDRONIC RADIANT FLOOR HEATING SYSTEM MATERIALS

A. Tubing

1. Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engle method

2. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third-party agency.

3. Pressure Ratings: Standard Grade hydrostatic design and pressure ratings as issued by the Plastics Pipe Institute (PPI), a division of the Society of the Plastics Industry (SPI).

4. Show compliance with ASTM E119 and ANSI/UL 263 through certification listings through UL.

a. UL Design No. L557 — 1 hour wood frame floor/ceiling assemblies

b. UL Design No. K913 — 2 hour concrete floor/ceiling assemblies

c. UL Design No. U372 — 1 hour wood stud/gypsum wallboard wall assemblies

d. UL Design No. V444 — 1 hour steel stud/gypsum wallboard wall assemblies

5. Minimum Bend Radius (Cold Bending): No less than six times the outside diameter. Use the PEX tubing manufacturer's bend supports if radius is less than stated.

6. Barrier Tubing Type: Wirsbo hePEX™ plus

a. Wirsbo hePEX plus tubing with an oxygen diffusion barrier does not exceed an oxygen diffusion rate of 0.10 grams per cubic meter per day at 104 degrees F (40 degrees C) water temperature in accordance with German DIN 4726.

b. Nominal Inside Diameter: Provide tubing with nominal inside diameter in accordance with ASTM F876, as indicated.

1) 5/16 inch [7.94mm]

2) ⅜ inch [9.53mm]

3) ½ inch [12.7mm]

4) ⅝ inch [15.88mm]

5) ¾ inch [19.05mm]

6) 1 inch [25.4mm]

B. Manifolds (commercial, valveless HDPE).

1. Install 2-, 3- or 4-inch high-density polyethylene (HDPE) manifolds manufactured from polyethylene (PE 3408) and offered by the respective PEX tubing manufacturer for system compatibility.

a. Manifold body pressure and temperature ratings are in accordance with ASTM D3350.

b. Manifold body dimensional tolerances are in accordance with ASTM D3035.

c. Manifold body is manufactured to a SDR of 11.

2. Install HDPE manifolds primarily in direct-burial applications.

3. Use HDPE manifolds approved for use in systems free of ferrous materials, or isolate ferrous material to eliminate corrosion damage due to oxygen diffusion.

4. Use HDPE manifolds applicable for systems operating up to a maximum of 140 degrees F (60 degrees C) at 80 psi (551 kPa).

5. Balancing

a. Design individual loop lengths across the manifold within 3 percent of each other in length.

b. Install supply and return piping to the manifold in a reverse-return configuration to ensure self-balancing.

c. If the supply and return piping is in direct-return configuration, install and balance flow setters on the return leg of each manifold to the mains.

6. Manifold outlets must feature ¾ inch or 1 inch Uponor ProPEX® fittings pressed onto the manifold outlet nipple by the manifold manufacturer.

C. Manifolds (commercial, valved copper)

1. For system compatibility, use 2-inch valved copper manifolds manufactured from Type L copper material, offered by the respective PEX tubing manufacturer.

2. Install valved copper manifolds primarily for wall-hung or boxed applications.

3. Use manifolds with an isolation valve or a combination isolation and balancing valve on each outlet.

4. Use manifolds that support ⅝ inch or ¾ inch PEX tubing.

5. Ensure manifold end cap offers tapping for ⅛ inch FNPT and ½ inch FNPT for vent and drain.

6. Install supply and return piping to the manifold in a reverse-return configuration to ensure self-balancing.

7. If the supply and return piping is in direct-return configuration, install and balance flow setters on the return leg of each manifold to the mains.

D. Fittings

1. For system compatibility, use fittings offered by the PEX tubing manufacturer.

2. The fitting assembly must comply with ASTM F877 and CAN/CSA B137.5 requirements.

3. Use Uponor QS20 compression fittings or Uponor ProPEX fittings as applicable.

4. Uponor QS20 Compression Fittings

a. Fitting assembly manufactured from UNS C3600 series brass material.

b. The fitting assembly consists of a barbed insert, a compression ring and a compression nut. The barbed insert is manufactured with an o-ring to facilitate air pressure testing.

5. Uponor ProPEX Fittings

a. Fittings manufactured in accordance with ASTM F1960.

b. Fitting assembly manufactured from material listed in paragraph 5.1 of ASTM F1960.

c. The fitting assembly consists of a barbed adapter and an applicable sized PEX ring. The barbed insert may include an o-ring to facilitate pressure testing with air.

E. Supply-and-return Piping to the Manifolds (above ground piping)

1. Properly size supply and return distribution piping for the given volume and velocities required at system design.

2. Use suitable distribution piping material (i.e., metric dimensioned Wirsbo hePEX plus, type M copper or black iron piping) for all supply fluid temperatures in systems with ferrous components.

a. When using 32mm through 63mm dimensioned Wirsbo hePEX plus tubing, do not exceed 194 degrees F (90 degrees C) at 58 psi (400 kPa).

3. Use suitable distribution piping material (i.e., Wirsbo AQUAPEX or HDPE) for systems free of or isolated from ferrous components.

a. When using HDPE mains, do not exceed 140 degrees F (60 degrees C) at 80 psi (551 kPa).

b. When using Wirsbo AQUAPEX mains, do not exceed 200 degrees F (93 degrees C) at 80 psi (551 kPa).

4. Do not expose Wirsbo AQUAPEX and metric dimensioned Wirsbo hePEX plus tubing to direct sunlight or install near overhead fluorescent lighting. If PEX tubing is exposed, install suitable pipe insulation around the exposed tubing.

5. Use fittings compatible with piping material. Fittings must transition from distribution piping to system manifolds.

F. Supply and Return Piping to the Manifolds (below ground piping)

1. Properly size supply and return distribution piping for the given volume and velocities required at system design.

2. Use suitable distribution piping material (i.e., metric dimensioned Wirsbo hePEX plus, type K copper or black iron) for all supply fluid temperatures in systems with ferrous components.

a. When using 32mm through 63mm dimensioned Wirsbo hePEX plus tubing, do not exceed 194 degrees F (90 degrees C) at 58 psi (400 kPa).

3. Use suitable distribution piping material (i.e., Wirsbo AQUAPEX or HDPE) for systems free of or isolated from ferrous components.

a. When using HDPE mains, do not exceed 140 degrees F (60 degrees C) at 80 psi (551 kPa).

b. When using Wirsbo AQUAPEX mains, do not exceed 200 degrees F (93 degrees C) at 80 psi (551 kPa).

4. If copper or black iron piping is embedded in concrete or soil, insulate or protect with sleeves.

5. Use fittings compatible with piping material. Fittings must transition from distribution piping to system manifolds.

PART 3 - INSTALLATION

3.01 GENERAL

A. Hydronic radiant heat tubing loops shall be installed in accordance with the manufacturer's recommendations and the details as shown on the contract drawings.

B. All fittings should be accessible for maintenance. Tubing loops shall be installed without splices, as a minimum, from the point at which the tubing enters the manifold to the point at which it exits the manifold.

C. Installation shall follow the drawings layout, tube spacing, manifold configuration, manifold location, and controls. All notes on the drawing shall be followed.

D. At start up time, the contractor shall: follow the manufacturer's recommendations for system water and temperature balancing and deliver to the owner any operation and maintenance manuals.

E. Pipes may extend through expansion joints (surface tool marks) in monolithic installation of concrete and reinforcing steel. All heating circuits to be attached to continuous reinforcing steel grid (minimum No. 10, 6 x 6) and embedded in concrete 2-3 inches below concrete surface.

F. Pipe connections, fittings and distribution manifolds shall not be embedded in concrete and shall be so arranged to be easily serviced. Wall box (recessed or surface mount) to housed manifold assembly shall be furnished and installed by the Mechanical Contractor.

G. Under slab insulation shall be provided as follows (Ref. Spec. G.C. Trades specs.):
   a. Entire slab or,
   b. where the ground condition is such that it retains moisture near the slab or,
   c. where the manufacturer of the radiant system recommends installing it.

3.02 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.

1. Uponor Complete Design Assistance Manual (CDAM), 5th edition

2. Uponor Radiant Floor Installation Handbook

3.03 EXAMINATION

A. Site Verification of Conditions

1. Verify that site conditions are acceptable for installation of the radiant floor heating system.

2. Do not proceed with installation of the radiant floor heating system until unacceptable conditions are corrected.

3.04 INSTALLATION

A. Slab-on-grade Installation

1. Fasten the tubing to the flat mesh or reinforcing bar in accordance with the PEX tubing manufacturer's installation recommendations.
2. Use closer tubing on-center distances along exterior walls. Increase tubing on-center distances as the installation moves away from the exterior wall.

a. Do not exceed 12 inches (305mm) on center.

b. Do not install tubing within 6 inches (152mm) of all walls.

c. Refer to the submitted radiant floor design layout.

3. If the design requires under-slab insulation, the structural engineer determines the vertical compressive strength of the high-density extruded board insulation. The radiant floor design determines the required insulation resistance value (R-value).
4. When using high-density board insulation, staple the tubing to the insulation board with Uponor Foam Staples.
5. Use edge insulation when the heated panel directly contacts an exterior wall or panel.
6. Install tubing at a consistent depth below the surface elevation as determined by the project engineer. Ensure sufficient clearance to avoid control joint cuts.
7. In areas where tubing must cross metal expansion joints in the concrete, ensure the tubing passes below the joints. Depending on the manufacturer's and structural engineer's recommendation, fibrous expansion joints may tolerate penetration.
8. For tubing that exits the slab in a 90-degree bend, use metal or PVC bend supports.

3.05 FIELD QUALITY CONTROL

A. Site Tests

1. To ensure system integrity, pressure test the system before covering tubing in concrete or when other trades are working in the vicinity of the tubing.
2. Test all electrical controls in accordance with respective installation manuals.

3.06 ADJUSTING

A. Balancing Across the Manifold

1. Balance all loops across each manifold for equal flow resistance based on actual loop lengths and total manifold flow.
2. Balancing is unnecessary when all loop lengths across the manifold are within 3 percent of each other in length. Install the supply and return piping to the manifold in a reverse-return configuration to ensure self-balancing.

B. Balancing between manifolds is accomplished with a flow control device installed on the return piping leg from each manifold when direct return piping is used for the supply and return mains.

3.07 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace damaged installed products.

C. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

D. Remove construction debris from project site and legally dispose of debris.

3.08 DEMONSTRATION

A. Demonstrate operation of hydronic radiant floor heating system to Owner's personnel.

B. Advise the owner's representative about the type and concentration of glycol and water solution if used in the hydronic radiant floor heating system.

1. The Owner monitors the solution effectiveness through an established maintenance program as outlined by the glycol manufacturer.

3.09 PROTECTION

A. Protect installed work from damage caused by subsequent construction activity on the site.

END OF SECTION 23 83 16
RADIANT-HEATING HYDRONIC PIPING

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SECTION 25 00 00

DIRECT DIGITAL CONTROL SYSTEM

Part 1: GENERAL

1.00 WORK PROPOSAL

The bid for building controls shall be furnished to the M.C. The controls contractor shall coordinate directly with both the 23 and 26 trades to complete a fully operable system.

1.01 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 05 00– Basic Mechanical Materials and Methods
   1. Control Valves
   2. Flow Switches
   3. Temperature Sensor Wells and Sockets
   4. Flowmeters
   5. VFD Motor drives

1.02 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

A. Section 23 05 00 – Basic Mechanical Materials and Methods
   1. Discharge Air Temperature Control
   2. Economizer Control
   3. Volume Control

1.03 RELATED SECTIONS

B. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of this specification and shall be used in conjunction with this section as a part of the contract documents. Consult them for further instructions pertaining to this work. The Contractor is bound by the provisions of Division 0 and Division 1.

C. The following sections constitute related work:
   1. SECTION 23 00 00 – GENERAL MECHANICAL PROVISIONS
   2. SECTION 23 05 00 - BASIC MECHANICAL MATERIAL METHODS
   3. SECTION 23 05 93 – TESTING, ADJUSTING AND BALANCE
   4. SECTION 26 00 00 – GENERAL ELECTRICAL PROVISIONS
   5. SECTION 26 05 00 – BASIC ELECTRICAL MATERIAL AND METHODS

1.04 DESCRIPTION

A. General: The control system shall be as shown and consist of a high-speed, peer-to-peer network of DDC controllers and operator workstation(s) residing and communicating on a BACnet IP (Internet Protocol) network. The operator workstation(s) shall be a personal computer (PC) with a color monitor, mouse, keyboard, and printer. The PC will allow a user to interface with the network via multi-tasking dynamic color graphics. Each mechanical system, building floor plan, and control device will be depicted by point-and-click graphics. A modem shall be provided for remote access to the network. Systems using gateways to route proprietary devices and objects to BACnet are not acceptable.

B. For Local Area Network installations provide access to the control system via the Internet. The owner shall provide a connection to the Internet via high-speed cable modem, ADSL, ISDN, T1 or through the facility ISP. The owner shall pay for all monthly Internet access fees and connection charges.

C. The control system shall be supplied with a complete web enabled package. The system shall support unlimited users using standard web browsers such as Internet Explorer and Netscape. The web server software shall operate on standard industry PC servers. Proprietary servers or “black boxes” are not acceptable. Web browser software shall be manufactured by the control system manufacturer and shall have the same look and feel as the operating system. Third party web software is not acceptable.

D. The system will provide for future expansion to include monitoring of the card access, fire alarm, and lighting control systems.

1.05 APPROVED CONTROL SYSTEM MANUFACTURERS

A. System shall be similar to **Reliable Controls**. Reference spec. 23 00 00 to submit equals.

1.06 QUALITY ASSURANCE

A. Contractor/Manufacturer Qualifications
   1. The Installer shall have an established working relationship with the Control System Manufacturer, and be the authorized representative of the Manufacturer at bid time.
   2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
   3. All products used in this installation shall be new, currently under manufacture, and shall be applied in standard off the shelf products. This installation shall not be used as a test site for any new products unless explicitly approved by the Engineer in writing. Spare parts shall be available for at least 5 years after completion of this contract.

1.07 CODES AND STANDARDS

A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:

   1. National Electric Code (NEC)
   2. Uniform Building Code (UBC)
      a) Section 608, Shutoff for Smoke Control
      b) Section 403.3, Smoke Detection Group B Office Buildings and Group R, Division 1 Occupancies
      c) Section 710.5, Wiring in Plenums
      d) Section 713.10, Smoke Dampers
      e) Section 1106 Refrigeration Machinery Rooms

f) Section 1107, Refrigeration Machinery Room Ventilation
g) Section 1108, Refrigeration Machinery Room Equipment and Controls
h) Section 1120, Detection and Alarm Systems

3. MICHIGAN MECH. CODE 2006
4. ASHRAE 135-2007
5. FCC Regulation, Part 15- Governing Frequency Electromagnetic Interference
6. Underwriters Laboratories UL916

1.08 SYSTEM PERFORMANCE

A. Performance Standards. The system shall conform to the following:
   1. Graphic Display. The system shall display a graphic with 20 dynamic points/objects with all current data within 10 seconds.
   2. Graphic Refresh. The system shall update a graphic with 20 dynamic points/objects with all current data within 8 seconds
   3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be less than 2 seconds. Analog objects should start to adjust within 2 seconds
   4. Object Scan. All changes of state and change of analog values will be transmitted over the high-speed Ethernet network such that any data used or displayed at a controller or workstation will have been current within the previous 2 seconds
   5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds

1.09 WARRANTY

A. Warrant all work as follows:
   1. Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.
   2. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period
   3. At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Engineer, the Engineer shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty.
   4. Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the Contractor shall be provided at no charge during the warranty period. Any upgrades or functional enhancements associated with the above mentioned items also can be provided during the warranty period for an additional charge to the Owner by purchasing an in-warranty technical support agreement from the Contractor. Written authorization by the Owner must, however, be granted prior to the installation of any of the above-mentioned items.
   5. Exception: The Contractor shall not be required to warrant reused devices, except for those that have been rebuilt and/or repaired. The Contractor shall

warrant all installation labor and materials, however, and shall demonstrate that all reused devices are in operable condition at the time of Engineer's acceptance.

Part 2: PRODUCTS

2.0 SECTION INCLUDES

1. Materials
2. Communication
3. Operator Workstation
4. Controller Software
5. Building Controllers
6. Advanced Application Controllers
7. Application Specific Controllers
8. Input/ Output Interface
9. Power Supplies and Line Filtering
10. Auxiliary Control Devices
11. Wiring and Raceways

2.01 MATERIALS

A. All products used in this project installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's Representative in writing. Spare parts shall be available for at least five years after completion of this contract.

2.02 COMMUNICATION

A. All control products provided for this project shall comprise a BACnet internetwork. Communication involving control components (i.e., all types of controllers and Operator Workstations) shall conform to ANSI/ASHRAE Standard 135-2001, BACnet.

B. Each BACnet device shall operate on the BACnet Data Link/Physical layer protocol specified for that device as defined in this section.

C. The Contractor shall provide all communication media, connectors, repeaters, bridges, hubs, switches, and routers necessary for the internetwork.

D. All controllers shall have a communication port for connections with the Operator Workstations using the BACnet Data Link/ Physical layer protocol.

E. A device on the internetwork shall be provided with a 56k-baud modem that will allow for remote Operator Workstation using the BACnet PTP Data Link/ Physical layer protocol. Remote Operator Workstation via this modem shall allow for communication with any and all controllers on this network as described in Paragraph F below.

F. Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:

1 Connection of an Operator Workstation device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status

information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.

2 All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform internetwork value passing.

G. The time clocks in all controllers shall be automatically synchronized daily. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the network.

H. The network shall have the following minimum capacity for future expansion:

1. Each Building Controller shall have routing capacity for 99 controllers.
2. The Building Controller network shall have capacity for 1000 Building Controllers.
3. The system shall have an overall capacity for 12,500 Building Controller, Advanced Application Controller, and Application Specific Controller input/output objects.

2.03 OPERATOR WORKSTATION

A. Operator Workstation. Furnish ONE PC-based workstations as shown on the system drawings. The workstation shall be able to access all information in the system. The workstation shall reside on the same Ethernet protocol network as the Building Controllers.

B. Workstation information access shall use the BACnet protocol. Communication shall use the ISO 8802-3 (Ethernet) Data Link/ Physical layer protocol.

C. Hardware. The operator workstation and custom programming workstation shall consist of the following:
1. Personal Computer. Furnish IBM compatible PCs as shown. The CPU shall be a minimum of an Intel Pentium and operate at a minimum of 900 MHz. A minimum of 256 megabytes of RAM, one 1.44 megabyte 3.5 inch diskette drive, CD drive and a 20GB hard disk with a minimum access time of 12 milliseconds shall be provided. A two-button mouse also will be provided. Furnish all required serial, parallel, and network communication ports, and all cables for proper system operation. The PC shall have a minimum of a 17" VGA monitor.
2. Modems. Furnish one auto-dial telephone modem per workstation and associated cables for communication to remote buildings and workstations. The modem shall transmit at a minimum of 56K baud, and communicate over voice-grade telephone lines and comply to BACnet data link Point-To-Point.
3. BACnet Interoperability Building Blocks.

D. System Software

1. Operating System. Furnish a concurrent multi-tasking operating system. The operating system also shall support the use of other common software applications that operate under Microsoft Windows. Examples include Lotus 123, Microsoft Excel, Microsoft Word, Microsoft Access. Acceptable operating systems are Windows 2000 Professional, Windows XP and Windows NT.

2. System Graphics. The operator workstation software shall be a graphical user interface (GUI). The system shall allow display of up to 10 dynamic and animated graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on-line. An operator with the proper password level shall be able to add, delete, or change dynamic objects on a graphic. Dynamic objects shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the object.

3. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics. The graphics generation package also shall provide the capability of capturing or converting graphics from other programs such as Visio or AutoCad

4. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program. Graphics shall be created by drag-and-drop selection of graphic symbols and drag-and-link with BACnet objects with dynamic and interactive display fields.

5. Multilingual. Software shall be supported in the following languages English, Spanish, French, German, Chinese.

6. Dynamic Data Exchange (DDE). Software shall support dynamic data sharing with other Windows-based programs for third party add-on functionality e.g. preventative maintenance, tenant billing, etc.

E. System Applications. Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation:

1. System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each Building Controller. This database shall be updated whenever an operator initiates a save command.

2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to save the database from any system panel. The operator shall be able to clear a panel database via the network and may initiate a download of a specified database to any panel in the system from the network.

3. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection.

4. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On- line help shall be available for

all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.

5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the functions accessible to viewing and/or changing each system application.

6. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers.

7. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, alarm limit differentials, states, and reactions for each object in the system.

8. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm, in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying upon acronyms or other mnemonics.

9. Alarm Reactions. The operator shall be able to determine (by object) what if any actions are to be taken during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation.

10. Trend Logs. The operator shall be able to define a custom trend log for any data object in the system. This definition shall include change-of-value digital, change-of-value analog, time interval, start time, and stop time. Trend data shall be sampled and stored on the Building Controller panel, and be archivable on the hard disk and be retrievable for use in spreadsheets and standard database programs.

11. Alarm and Event Log. The operator shall be able to view all system alarms and change of states from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms.

12. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system. The status shall be available by menu, on graphics, or through custom programs.

13. Clock Synchronization. The real-time clocks in all building control panels and workstations shall be using the BACnet Time Synchronization service. The system also shall be able to automatically synchronize all system clocks daily from any operator-designated device in the system. The system shall automatically adjust for daylight savings and standard time, if applicable.

F. Workstation Applications Editors. Each PC workstation shall support editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloaded and executed at one or more of the controller panels.

1. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and setpoints for all controllers.

2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and month. This shall consist of a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The start and stop times for each object shall be adjustable from this master schedule.

3. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The programming language shall have the following features:
   a. The language shall be English language oriented, be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and allow for free-form programming (i.e., not column-oriented or "fill in the blanks").
   b. A full-screen character editor/programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete custom programming code. It also shall incorporate word processing features such as cut/paste and find/replace.
   c. The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
   d. The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and observe any intermediate values and/or results. The debugger also shall provide error messages for syntax and execution errors.
   e. The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
   f. The programming language shall support floating point arithmetic using the following operators: +, -, /, x, square root, and x-to-the-y-power. The following mathematical functions also shall be provided: natural log, log, trigonometric functions (sine, cosine, etc.), absolute value, and minimum/maximum value from a list of values.
   g. The programming language shall have predefined variables that represent time of day, day of the week, month of the year, and the date. Other predefined variables shall provide elapsed time in seconds, minutes, hours, and days. These elapsed time variables shall be able to be reset by the language so that interval-timing functions can be stopped and started within a program. Values from all of the above variables shall be readable by the language so that they can be used in a program for such purposes as IF/THEN comparisons, calculations, etc.
   h. The language shall be able to read the values of the variables and use them in programming statement logic, comparisons, and calculations.
   i. The programs shall support online changes with the ability to read real time values without exiting the program. Sample programs and syntax help functions shall be resident in the program.

G. REPORT MANAGEMENT

1.The following reporting capability shall be provided at the operator workstation.

2.Reporting:

a. Internal reports built into operator workstation software
b. External reporting via ODBC

3. Internal Reports
   a. User definable query reports (support advanced multiple property, multiple object).
   b. Reports shall be scheduled for automatic generation by schedule or event.
   c. Manual execution to printing/file.
   d. Ability to save report in system report folder.
   e. Query controller hierarchy.
   f. Report to multiple destinations
      i. Email
      ii. Print
      iii. File (text, csv, xml)
      iv. Terminal

4. Enterprise Interface
   a. ODBC driver supporting common SQL statements (select, update, insert, where, order by, group by, etc.)
   b. Allow integration to Enterprise software
   c. Shall be capable of being used with third party software that supports ODBC connection such as: Microsoft Access, Excel, Crystal Reports, etc.
   d. All queries shall be real time into live controller network.
   e. Shall be able to both read and write using SQL.

H. SERVER FUNCTIONS AND HARDWARE

1. A central server, located in the store managers office shall be provided. The server shall support all Network Area Controllers connected to the customer's network whether local or remote. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.

2. The server shall provide scheduling for all Area Controllers and their underlying field control devices.

3. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.

4. The server shall provide central management of alarm data for all Network Area controllers supported by the server inclusive of the following:
   a. View and acknowledge alarms

6. Server Hardware Requirements: The server hardware platform shall have the following requirements:
   a. The computer shall be an Intel Pentium P4 based computer (minimum processing speed of 1.3 GHz with 128 MB RAM and a 10-gigabyte minimum hard drive). It shall include a 32x CD Rom Drive, 3.5" floppy drive, 2 10/100 Ethernet cards, 1024x768 True Color Video Card

b. The server operating system shall be Microsoft Windows 2000 Professional or Microsoft Windows Server.

2.04 CONTROLLER SOFTWARE

A. Furnish the following applications software for building and energy management. All software applications shall reside and operate in the system controllers. Editing of applications shall occur at the operator workstation

B. System Security

1. User access shall be secured using individual security passwords and user names.

2. Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.

3. User Log On/Log Off attempts shall be recorded.

C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each schedule shall consist of the following:

1. Weekly Schedule. Provide separate schedules for each day of the week. Each of these schedules should include the capability for start, stop and optimal start. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to adjust the start and stop times for each member.

2. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

D. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions.

E. Remote Communication. The system shall have the ability to dial out in the event of an alarm using BACnet Point-To-Point at a minimum of 56K baud. Receivers shall be BACnet workstations.

F. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user-designated run-time, starts, and/or calendar date limits.

G. Sequencing. Provide application software to properly sequence the start and stop of chillers, boilers, and pumps to minimize energy usage in the facility.

H. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-windup shall be supplied. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, setpoint, and PID gains shall be user-selectable.

I. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage.

J. Energy Calculations. Provide software to allow instantaneous power (e.g., kW) or flow rates (e.g., L/s [GPM]) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window kW demand value.

K. Anti-Short Cycling. All binary output objects shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

L. On/Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and setpoint. The algorithm shall be direct-acting or reverse-acting, and incorporate an adjustable differential.

M. Run-time Totalization. Provide software to totalize run-times for all binary input objects. A high run-time alarm shall be assigned, if required, by the operator.

2.05 BUILDING CONTROLLERS

A. General. Provide an adequate number of Building Controllers to achieve the performance specified in the Part 1 Article on "System Performance." Each of these panels shall meet the following requirements.

1. The Energy Management and Control System shall be comprised of one or more independent, standalone, microprocessor-based Building Controllers to manage the global strategies described in the System Software section.

2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.

3. Data shall be shared between networked Building Controllers.

4. The operating system of the Building Controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information, and allow central monitoring and alarms.

5. Controllers that perform scheduling shall have a real-time clock.

6. The Building Controller shall support the following BACnet Interoperability Building Blocks (BIBBs):

Data Sharing	Alarm & Event	Scheduling	Trending	Device & Network Mgmt.
DS-RP-A,B	AE-N-B	SCHED-B	T-VMT-B	DM-DDB-A,B
DS-RPM-A,B	AE-ACK-B		T-ATR-B	DM-DOB-A,B
DS-WP-A,B	AE-ASUM-B			DM-DCC-B
DS-WPM-B	AE-ESUM-B			DM-TS-B
DS-COVU-A,B				DM-UTC-B
				DM-RD-B
				DM-BR-B
				NM-CE-A

B. Communication

1. Each Building Controller shall support direct Ethernet or a communications card. The communications card shall be connected to the Building Controller by an PC-104 bus connection. The Building Controller shall be connected to the BACnet network using the ISO 8802-3 (Ethernet) Data Link/ Physical layer protocol.

2. Each Building Controller with a communications card shall perform BACnet routing if connected to a network of Custom Application and Application Specific Controllers.

3. The controller shall provide a service communication port using BACnet Data Link/ Physical layer protocol P-T-P for connection to a hand-held workstation/ and/or modem.

4. The Building Controller secondary communication network shall support BACnet MS/TP.

C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at 0℃ to 40℃ [32℉ to 100℉] and 10 to 90% RH.

2. Controllers used in conditioned space shall be mounted in dust-proof enclosures, and shall be rated for operation at 0℃ to 50℃ [32 ℉ to 120℉].

D. Building Controllers shall be fully peer to peer.

E. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field- removable, modular terminal strips — or to a termination card connected by a ribbon cable.

F. Memory. The Building Controller shall have as a minimum standard SRAM of 256 KB, standard DRAM of 1MB and standard non-volatile 1 MB of flash memory in lieu of EPROM. Memory shall be user extendible through RAM chip sockets and SIMMs for future memory expansion.

G. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. The Building Controller shall maintain all database information including BIOS and programming information in the event of a power loss for at least 72 hours. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m [3 ft].

H. Inputs/Outputs.

1. Inputs. Controller input/output board shall support dry contact, 0-5 VDC and 0-10 VDC- voltage, 4-20 mA- current and thermistor-resistive signal types on an individual basis for connecting any status or sensing device. Analog resolution shall be 10-bit A to D.

2. Ouputs. Controller input/output board shall support plug-and-play I/O modules or built in HOA modules configured with manual-auto-off override switch, potentiometer and input channel for feedback status or and unrelated analog or digital input. Output supported shall be 0-10 VDC. All HOA’s shall be supervised.

3. Diagnostics. Controller input/output board shall have red LEDs providing input status indication.

4. External Power. Controller input/ouput board shall have one on-board 24 VDC terminal for directly connected active transducers.

5. Building Controller shall have the capability to create, delete and support the following BACnet Objects:
   a. ANALOG INPUT, ANALOG OUTPUT AND ANALOG VALUE: These objects shall have the following writeable properties: Object Name; Object Value; Description; COV Increment; Out of Service and Units. In addition, these objects shall support the properties: Device type; Reliability; Min./Max. Values; Update Interval and Resolution.
   b. BINARY INPUT, BINARY OUTPUT AND BINARY VALUE: These objects shall have the following writeable properties: Object Name; Object Value; Desription; Polarity; Default Value; Min On/Off and Out of Service. In addition, these objects shall support the properties: Device Type; Reliability; Active/Inactive Texts; Update Interval; Resolution; Change-of-State Time; Count Times and Time Reset.
   c. CALENDAR: This object shall have the following writeable properties: Object Name; Object Value; Description; and Date List.
   d. DEVICE: This object shall have the following writeable properties: Object Name; Description; Location; and UTC Offset.
   e. EVENT ENROLMENT: This object shall have the following writeable properties: Object Name; Object Value; Description; Out-of-Service; Event & Notify Types; Parameters; Property Ref; Enable; and Notification Class.
   f. FILE: This object shall have the following writeable properties: Object Name; Description; File Type; and File Access.
   g. LOOP (PID): This object shall have the following writeable properties: Object Name; Object Value; Description; Polarity; Output and Input Refs.; Input Value & Units; Setpoint Value; PID Values; Bias; Write Priority and COV Increment. In addition, this object shall support the properties: Reliability; Update Interval; Proportional Constant & Units; Derivative Constant & Units.
   h. NOTIFICATION CLASS: This object shall have the following writeable properties: Object Name; Object Value; Description; Priority and Ack Required.
   i. PROGRAM: This object shall have the following writeable properties: Object Name; Object Value and Description. In addition, this object shall support the property Reliability.
   j. SCHEDULE: This object shall have the following writeable properties: Object Name; Object Value and Description; Effective period; Schedule; Exception; Controlled Properties and Write Properties.
   k. TREND LOG: This object shall have the following writeable properties: Object Name; Description; Log Enable; Start/stop Times; Log Device Object Property; Log Interval; Stop When Full; Buffer Size; and Record Count.

2.06 APPLICATION SPECIFIC CONTROLLERS

A. General. Application Specific Controllers (ASCs) are microprocessor-based DDC controllers which through hardware or firmware design are able to control a wide variety of equipment. They are fully user-programmable, and are not restricted to any one type of equipment.

1. Each ASC shall be capable of standalone operation and shall continue to provide control functions without being connected to the network

2. Each ASC will contain sufficient I/O capacity to control the target system.

3. Both firmware and controller database shall be loadable over the network

4. Application Specific Controllers shall be fully peer to peer

5. ASC's shall come with an integrated housing to allow for easy mounting and protection of the circuit board. Only wiring terminals shall be exposed.

6. Application Specific Controllers shall support the following BACnet Interoperability Building Blocks (BIBBs):

Data Sharing	Alarm & Event	Scheduling	Trending	Device & Network Mgmt.
DS-RP-B				DM-DDB-B
DS-WP-B				DM-DOB-B
				DM-DCC-B

B. Communication

1. The controller shall reside on a BACnet network using the MS/TP Data Link/ Physical layer protocol.

2. Each controller shall have a BACnet Data Link/ Physical layer compatible connection for a laptop computer or a portable operator's tool. This connection shall be extended to a space temperature sensor port where shown and allow access to the entire network.

3. Each controller shall have a secondary subnetwork for communicating sensors or I/O expansion modules

C. Environment. The hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40℃ to 65℃ [-40℉ to 150℉] and/or suitably installed in a hea ted or fan cooled enclosure

2. Controllers used in conditioned space shall be mounted in dust-proof enclosures, and shall be rated for operation at 0℃ to 50℃ [32 ℉ to 120℉].

D. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips.

E. Memory. The Application Specific Controller shall use non-volatile memory and maintain all BIOS and programming information in the event of a power loss.

F. Immunity to power and noise. ASC shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m [3 ft].

G. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

H. Input/Output. ASC shall support as a minimum, directly connected, a combination of analog outputs and binary outputs and universal software selectable analog or digital inputs. ASC inputs shall support 0-5 VDC-voltage, 4-20mA-current, thermistor-

resistance and dry contacts. ASC outputs shall support 0-10 VDC-voltage, digital triac rated at 0.5 amps at 24 VAC

I. System Object Capacity. The system size shall be expandable to at least twice the number of input/output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The Operator Workstations installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.08 INPUT/OUTPUT INTERFERENCE

A. Hardwired inputs and output points/objects may be wired into the system through Building, Custom Application, or Application Specific Controllers.

B. All input and output points shall be protected such that shorting of the point to itself, to another point, or to ground, will cause no damage to the controller. All input and output points shall be protected from voltage up to 24 volts of any duration, such that contact with this voltage will cause no damage to the controller.

C. Digital inputs shall allow the monitoring of ON/OFF signals from remote devices. The digital inputs shall provide a current of at least 12 mA to be compatible with commonly available control devices, and shall be protected against the effects of contact bounce and noise. Digital inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

D. Analog inputs shall allow the monitoring of 0-5 VDC, 0-10 VDC-voltage, 4-20 mA-current, or thermistors. Analog inputs shall be compatible, and be field configurable to commonly available sensing devices.

E. Digital outputs shall provide for ON/OFF operation. Digital outputs on Building and Advanced Application Controllers shall have three-position override switches, Hand-Off-Auto with status lights. Outputs shall be selectable for either normally open or normally closed operation.

F. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide a 0 to 10 VDC signal as required to provide proper control of the output device. Analog outputs on Building or Advanced Application Controllers shall have status lights and a two-position (AUTO/MANUAL) switch and manually adjustable potentiometer for manual override. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.

G. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct mounted heating coils, zone dampers, radiation, etc.)

H. Input/Output points/objects shall be universal type, i.e., controller input or output may be designated (in software) as either a binary or analog type point/object with appropriate properties. Application Specific Controllers are exempted from this requirement.

I. System Object Capacity. The system size shall be expandable to at least twice the number of input/output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this

capacity requirement. The Operator Workstations installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.09 POWER SUPPLIES AND LINE FILTERING

A. Control transformers shall be UL Listed. Furnish Class 2 current-limiting type, or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Limit connected loads to 80% of rated capacity.

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection, and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.
   a. Unit shall operate between 0℃ and 50℃ [32℉ an d 120℉]. EM/RF shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810C for shock and vibration.
   b. Line voltage units shall be UL Recognized and CSA Approved.

B. Power line filtering.

1. Provide transient voltage and surge suppression for all workstations and controllers either internally or as an external component. Surge protection shall have the following at a minimum:
   a. dielectric strength of 1,000 volts minimum
   b. response time of 10 nanoseconds or less
   c. transverse mode noise attenuation of 65 dB or greater
   d. common mode noise attenuation of 150 dB or better at 40 Hz to 100 Hz.

2.10 AUXILIARY CONTROL DEVICES

A. Motorized control dampers, unless otherwise specified elsewhere, shall be as follows:

1. Control dampers shall be parallel or opposed blade type as below or as scheduled on drawings.
   a. Outdoor and/or return air mixing dampers and face and bypass (F&BP) dampers shall be parallel blade, arranged to direct air-streams toward each other.
   b. Other modulating dampers shall be opposed blade type.
   c. Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.

2. Damper frames shall be 13 gauge galvanized steel channel or 1/8" extruded aluminium with reinforced corner bracing.

3. Damper blades shall not exceed 20 cm [8"] in width or 125 cm [48"] in length. Blades are to be suitable for medium velocity performance (10 m/s [2,000 fpm]). Blades shall be not less than 16 gauge.

4. Damper shaft bearings shall be as recommended by manufacturer for applica-tion, Oilite or better.

5. All blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 50 L/s·m² [10 cfm per sq. ft.] at 1000 Pa [4" w.c.] differential pressure. Provide air foil blades suitable for a wide-open face velocity of 7.5 m/s [1,500 fpm].

6. Individual damper sections shall not be larger than 125 cm x 150 cm [48" x 60”]. Provide a minimum of one damper actuator per section.

7. Modulating dampers shall provide a linear flow characteristic where possible.

8. Dampers shall have exposed linkages.

B. Electric damper/valve actuators.

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

2. Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing.

3. All rotary spring-return actuators shall be capable of both clockwise or counter-clockwise spring-return operation. Linear actuators shall spring-return to the retracted position.

4. Proportional actuators shall accept a 0 to 10 VDC or 2 to 10vdc operating range.

5. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not require more than 11 VA.

6. All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring-return actuators with more than 7 N·m [60 in-lb] torque capacity shall have a manual crank for this purpose.

7. Actuators shall be provided with a raceway fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections

8. Actuators shall be UL Standard 873 Listed and CSA Class 4813 02 Certified as meeting correct safety requirements and recognized industry standards.

9. Actuators shall be designed for a minimum of 60,000 full-stroke cycles at the actuator's rated torque.

C. Control valves.

1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.

2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
   a. Water Valves:

i. Two-way: 150% of total system (pump) head.
ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

b. Steam Valves: 150% of operating (inlet) pressure.

3. Water Valves:

a. Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.

b. Sizing Criteria:
i. Two-position service: Line size.
ii. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35kPa [5 psi], whichever is greater
iii. Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa [5 psi] maximum.
iv. Valves ½" through 2" shall be bronze body or cast brass ANSI Class 250, spring-loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
v. 2½" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing.

c. Water valves shall fail normally open or closed as scheduled on plans, or as follows:
i. Water zone valves - normally open {preferred}.
ii. Heating coils in air handlers - normally open
iii. Chilled water control valves - normally closed.
iv. Other applications - as scheduled or as required by sequences of operation.

4 Steam Valves:

a. Body and trim materials shall be per manufacturer's recommendations for design conditions and service. Linear ports for modulating service.

b. Sizing Criteria:
i. Two-position service: pressure drop 10% to 20% of inlet psig.
ii. Modulating service: 100 kPa [15 psig] or less: pressure drop 80% of inlet psig.
iii. Modulating service: 101 to 350 kPa [16 to 50 psig]: pressure drop 50% of inlet psig.
iv. Modulating service: over 350 kPa [50 psig]: pressure drop as scheduled on plans

D. Binary Temperature Devices

1 Low-voltage space thermostat shall be 24 V, bimetal-operated, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13℃ to 30℃ [55℉ to 85℉] setpoint range, 1℃ [2℉] maxim um differential, and vented ABS plastic cover.

2 Line-voltage space thermostat shall be bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed setpoint adjustment, 13℃ to 30℃ [55℉ to 85℉] setpoint range, 1℃ [2° F] maximum differential, and vented ABS plastic cover.

3 Low-limit thermostats. Low-limit thermostats shall be vapor pressure type with an element 6 m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any 30 cm [1 ft] section. The low-limit thermostat shall be manual reset only and be supplied as DPST.

E. Temperature sensors.

1. Temperature sensors shall be thermistors.

2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5 m [5 feet] in length.

3. Immersion sensors shall be provided with a separable brass well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.

4. Space sensors shall be equipped with the following:

a. programmable buttons for setpoint adjustment and override

b. 3-value, 96-segment LCD display

F. Humidity sensors.

1. Duct and room sensors shall have a sensing range of 20% to 80%.

2. Duct sensors shall be provided with a sampling chamber.

3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH. They shall be suitable for ambient conditions of -40℃ to 75℃ [-40℉ to 170℉].

4. Humidity sensor's drift shall not exceed 3% of full scale per year.

G. Flow switches.

1 Flow-proving switches shall be either paddle or differential pressure type, as shown.

2 Paddle type switches (water service only) shall be UL Listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 enclosure unless otherwise specified.

3 Differential pressure type switches (air or water service) shall be UL Listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as specified.

H. Relays.

1. Control relays shall be UL Listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application

2. Time delay relays shall be UL Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from setpoint shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

I. Override timers.

1. Override timers shall be spring-wound line voltage UL Listed, contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified; suitable for flush mounting on control panel face, located on local control panels or where shown.

J. Current transmitters

1. AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 0 – 5vdc two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, internal zero and span adjustment, and ±1% full scale accuracy at 500 ohm maximum burden

2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.

3. Unit shall be split-core type for clamp-on installation.

K. Current transformers

1. AC current transformers shall be UL/CSA recognized and completely encased (except for terminals) in approved plastic material.

2. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full scale output.

3. Transformers shall be split-core type for installation on new or existing wiring,

L. Voltage transmitters

1. AC voltage transmitters shall be self-powered single loop (two-wire) type, 4 to 20 mA output with zero and span adjustment.

2. Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with ±1% full-scale accuracy with 500 ohm maximum burden.

3. Transmitters shall be UL/CSA recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.

M. Voltage transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 VAC rated, complete with built-in fuse protection.

2. Transformers shall be suitable for ambient temperatures of 4 to 55℃ [40 to 130℉] and shall provide ±0.5% accuracy at 24 VAC and a 5 VA load.

3. Windings (except for terminals) shall be completely enclosed with metal or plastic material.

N. Power monitors.

1. Power monitors shall be three-phase type furnished with three-phase disconnect/shorting switch assembly, UL Listed voltage transformers and UL Listed split-core current transformers

2. Shall provide a selectable rate pulse output for kWh reading and a 1 –5vdc or 4 to 20 mA output for kW reading. Shall operate with 5 A current inputs with a maximum error of ±2% at 1.0 power factor or ±2.5% at 0.5 power factor.

O. Current switches

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

P. Pressure transducers

1. Transducer shall have linear output signal. Zero and span shall be field-adjustable.

2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage

3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 1 - 5vdc or 4 to 20 mA output, required mounting brackets, and block and bleed valves.

4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 1 – 5vdc or 4 to 20 mA output, required mounting brackets, and five-valve manifold.

Q. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as shown.

R. Pressure-Electric (PE) Switches

1. Shall be metal or neoprene diaphragm actuated, operating pressure rated 0–175 kPa [0–25 psig], with calibrated scale setpoint range of 14–125 kPa [2–18 psig] minimum, UL listed

2. Provide one- or two-stage switch action SPDT, DPST, or DPDT, as required by application.

3. Shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified

4. Shall have a permanent indicating gauge on each pneumatic signal line to PE switches.

S. Electro-pneumatic (E/P) transducers

1. Electronic/pneumatic transducer shall provide a proportional 20 to 100 kPa [3 to 15 psig] output signal from a 0 to 10 VDC analog control input.

T. Local control panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with [hinged door], key-lock latch, removable sub-panels. A single key shall be common to all field panels and sub-panels

2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings

3. Provide 120v receptacle at each local panel location.

2.11 WIRING AND RACEWAYS

A. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 16.

B. All insulated wire to be copper conductors, UL labeled for 90C minimum service.

PART 3: EXECUTION

3.0 SECTION INCLUDES

1. Examination
2. Protection
3. Coordination
4. General Workmanship
5. Field Quality Control
6. Existing Equipment
7. Wiring
8. Communication Wiring
9. Fiber Optic Cable
10. Control Air Tubing
11. Installation of Sensors
12. Flow Switch Installation
13. Actuators
14. Warning Labels
15. Identification of Hardware and Wiring
16. Controllers
17. Programming
18. Control System Checkout and Testing

19. Control System Demonstration and Acceptance
20. Cleaning
21. Training
22. Sequences of Operation

3.01 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started

B. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started

C. The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate — or if any discrepancies occur between the plans and the Contractor's work, and the plans and the work of others — the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by — and at the expense of — this Contractor.

3.02 PROTECTION

A. The Contractor shall protect all work and material from damage by its work or employees, and shall be liable for all damage thus caused

B. The Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects

3.03 COORDINATION

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs its work before coordinating with other trades, so as to cause any interference with work of other trades, the Contractor shall make the necessary changes in its work to correct the condition without extra charge

2. Coordinate and schedule work with all other work in the same area, or with work which is dependent upon other work, to facilitate mutual progress.

B. Submittals. Refer to the "Submittals" Article in Part 1 of this specification for requirements

C. Test and Balance

1. The Contractor shall furnish all tools necessary to interface to the control system for test and balance purposes

2. The Contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours

3. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.

4. The tools used during the test and balance process will be returned at the completion of the testing and balancing

D. Life Safety

1. Duct smoke detectors required for air handler shutdown are supplied and installed under Division 16. The Division 16 Contractor shall interlock smoke detectors to air handlers for shutdown as described in Part 3: “Sequences of Operation”.

2. Smoke dampers and actuators required for duct smoke isolation are provided under another Division 15 Section

3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Division 15 Section. Control of these dampers shall be by Division 16.

E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the Contractor as follows:

1. All communication media and equipment shall be provided as specified in Part 2: “Communication” of this specification.

2. Each supplier of controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.

3. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this Section and those provided under other sections or divisions of this specification.

3.04 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment

C. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).

D. All wiring shall be verified for its integrity to ensure continuity and freedom from shorts and grounds

E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.05 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship

C. Contractor shall have work inspected by local and/or state/provincial authorities having jurisdiction over the work

3.07 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification. Where the requirements of this section differ with those in Division 26, the requirements of this section shall take precedence

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 26 requirement

C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations including ceiling return air plenum, approved cables not in raceway may be used, provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenum shall be UL Listed specifically for that purpose.

E. All wiring in mechanical, electrical, or service rooms — or where subject to mechanical damage — shall be installed in raceway at levels below 3m [10ft].

F. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

G. Do not install wiring in raceway containing tubing

H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it, and *neatly* tied at 2m [6ft] intervals

I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems

J. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals

L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the Contractor shall provide step-down transformers.

M. All wiring shall be installed as continuous lengths, with no splices permitted between termination points/objects

N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations

O. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements, except as noted elsewhere.

P. Include one pull string in each raceway 2.5 cm [1"] or larger

Q. Use coded conductors throughout with different colored conductors

R. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

S. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15cm [6”] from high-temperature equipment (e.g., steam pipes or flues).

T. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

U. Adhere to Division 16 requirements where raceway crosses building expansion joints

V. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

W. The Contractor shall terminate all control and/or interlock wiring, and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site

X. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1 m [3 ft] in length and shall be supported at each end. Flexible metal raceway less than ½ “ electrical trade size shall not be used. In areas exposed to moisture — including chiller and boiler rooms — liquid-tight, flexible metal raceways shall be used.

Y. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed

3.08 COMMUNICATION WIRING

A. The Contractor shall adhere to the items listed in the “Wiring” Article in Part 3 of the specification

B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

C. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring

D. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.

E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lighting arrestor shall be installed according to the manufacturer's instructions

G. All runs of communication wiring shall be unspliced length when that length is commercially available

H. All communication wiring shall be labeled to indicate origination and destination data.

I. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding

3.10 INSTALLATION OF SENSORS

A. Install all sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing

D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings

E. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip

F. Low limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m^2 [1 ft of sensing element for each 1 ft^2] of coil area

G. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

H. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

I. Differential air static pressure

1. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable), or to the location of the duct high-pressure tap and leave open to the plenum.

2. Return Duct Static Pressure: Pipe the low-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor

3. Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover at the specified location

4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer

5. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment

6. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.

3.11 FLOW SWITCH INSTALLATION

A. Use correct paddle for pipe diameter.

B. Adjust flow switch in accordance with manufacturer's instructions

3.12 ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.

To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage

Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations

2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.14 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 5 cm [2"] of termination with the DDC address or termination number.

B. All pneumatic tubing shall be labeled at each end within 5 cm [2"] of termination with a descriptive identifier.

C. Permanently label or code each point/object of field terminal strips to show the instrument or item served.

D. Identify control panels with minimum 1 cm [½"] letters on laminated plastic nameplates.

E. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.

F. Identify room sensors relating to terminal box or valves with nameplates.

G. Manufacturers' nameplates

H. Identifiers shall match record documents

3.15 CONTROLLERS

A. Provide a separate controller for each AHU or other HVAC system. Combining systems to one controller shall only be done with the engineers approval.

B. Building Controllers and Advanced Application Controllers shall be selected to provide a minimum of 15% spare I/O point/object capacity for each point/object type found at each location. If input /objects are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point/object used.

1. Future use of spare capacity shall require providing the field device, field wiring, point/object database definition, and custom software. No additional controller boards or point/object modules shall be required to implement use of these spare points

3.16 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Point/object Naming: System point/object names shall be modular in design, allowing easy operator interface without the use of a written point/object index. Use the following naming convention:

AAABBBCCCDDDEEE where:

AAA is used to designate the location of the point/object within the building such as mechanical room, wing, or level, or the building itself in a multi-building environment.

BBB is used to designate the mechanical system with which the point/object is associated (e.g., A01, HTG, CLG, LTG).

CCC represents the equipment or material referenced (e.g., SAF for supply air fan , EXF for exhaust fan, RAF for return air fan).

D or *DD* or *DDD* may be used for clarification or for identification if more than one of CCC exists (e.g., SAF10, EXF121).

EEE represents the action or state of the equipment or medium (e.g., T for temperature, RH for humidity, CO for control, S for status, D for damper control, I for current).

C. Software Programming

1. Provide programming for the system and adhere to the sequences of operation provided. The Contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
   a. Text-based:
      i. must provide actions for all possible situations
      ii. must be modular and structured
      iii. must be commented
   b. Graphic-based
      i. must provide actions for all possible situations
      ii. must be documented
   c. Parameter-based
      i. must provide actions for all possible situations
      ii. must be documented

D. Operator Interface

Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point/object information on the graphic displays shall dynamically update. Show on each graphic all input and output points/objects for the system. Also show relevant calculated points/objects such as setpoints

Sow terminal equipment information on a “graphic” summary table. Provide dynamic information for each point/object show

The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all Operator Workstation software and their functions as described in this section. This includes any operating system software, the Operator Workstation database, and any third-party software installation and integration required for successful operation of the operator interface

3.17 CONTROL SYSTEM CHECKOUT AND TESTING

A. Start-up Testing: All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner’s Representative is notified of the system demonstration.

1. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification

2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight

3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations

4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct

5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel

6. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.

7. Alarms and Interlocks

   a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm

   b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

   c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.18 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration

Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests

The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the "Control System Checkout and Testing" Article in Part 3 of this specification. The Engineer will be present to observe and review these tests. The Engineer shall be notified at least 10 days in advance of the start of the testing procedures.

The demonstration process shall follow that approved in Part 1: "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration

The Contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every

point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor.

As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.

Demonstrate compliance with Part 1: “System Performance

Demonstrate compliance with Sequences of Operation through all modes of operation

Demonstrate complete operation of Operator Workstation

Additionally, the following items shall be demonstrated:

a) DDC Loop Response. The Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in setpoint, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the setpoint, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
b) Demand limiting. The Contractor shall supply a trend data output showing the action of the demand-limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting setpoint, and the status of shed-able equipment outputs.
c) Optimum Start/Stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas
d) Interface to the building fire alarm system
e) Operational logs for each system that indicate all setpoints, operating points, valve positions, mode, and equipment status shall be submitted to the Architect/Engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
f) Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance

1. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Engineer. Such tests shall then be performed as part of the warranty.

2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: "Submittals."

3.19 CLEANING

1. The Contractor shall clean up all debris resulting from its activities daily. The Contractor shall remove all cartons, containers, crates, etc., under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

2. At the completion of work in any area, the Contractor shall clean all of its work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

3. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.20 TRAINING

A. General
   1. Provide a minimum of one onsite training class 8 hours in length during the construction period for personnel designated by the owner.
   2. Provide two additional training sessions at 6 and 12 months following building's turnover. Each session shall be 8 hrs in length and must be coordinated with the building Owner.

B. Train the designated staff of Owner's Representative and Owner to enable Day-to-day Operators to:
   1. Proficiently operate the system.
   2. Understand control system architecture and configuration.
   3. Understand DDC system components.
   4. Understand system operation, including DDC system control and optimizing routines (algorithms).
   5. Operate the workstation and peripherals.
   6. Log on and off the system.
   7. Access graphics, point/object reports, and logs.
   8. Adjust and change system setpoints, time schedules, and holiday schedules.
   9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
   10. Understand system drawings, and Operation and Maintenance manual.
   11. Understand the job layout and location of control components.
   12. Access data from DDC controllers and ASC.
   13. Operate portable operator's terminals.

C. Train the designated staff of Owner's Representative and Owner to enable Advanced Operators to:

   1. Make and change graphics on the workstation
   2. Create, delete, and modify alarms, including annunciation and routing of these
   3. Create, delete, and modify point/object trend logs, and graph or print these
   4. Create, delete, and modify reports

5. Add, remove, and modify system's physical points/objects
6. Create, modify, and delete programming
7. Add panels when required
8. Add Operator Workstation stations
9. Create, delete, and modify system displays — both graphical and otherwise
10. Perform DDC system field checkout procedures
11. Perform DDC controller unit operation and maintenance procedures
12. Perform workstation and peripheral operation and maintenance procedures
13. Perform DDC system diagnostic procedures
14. Configure hardware including PC boards, switches, communication, and I/O points/objects
15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
16. Adjust, calibrate, and replace system components

D. Train the designated staff of Owner's Representative and Owner to enable System Managers/Administrators to:

1. Maintain software and prepare backups
2. Interface with job-specific, third-party operator software
3. Add new users and understand password security procedures

E. Provide course outline and materials as per "Submittals" Article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.

F. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

G. Classroom training shall be done using a network of working controllers representative of the installed hardware.

END OF SECTION 25 00 00
DIRECT DIGITAL CONTROL SYSTEM

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SECTION 25 51 00

SEQUENCE OF OPERATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Heating / Cooling water loops

B. Heating / Cooling Circulating Pumps.

C. Fan Coil units.

D. Exhaust fans.

E. Cabinet Unit Heaters

F. Boilers

G. Heat Pump units.

1.02 SYSTEM DESCRIPTION

A. This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other Sections or must be provided as required to meet Sequence of Operation.

1.03 RELATED SECTIONS

A. Section 23 00 00 – MECHANICAL GENERAL PROVISIONS
B. Section 23 05 00 – BASIC MECHANICAL MATERIALS AND METHODS
C. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING
D. Section 25 00 00 – DIRECT DIGITAL CONTROL SYSTEMS

1.04 SUBMITTALS

A. Submit under provisions of Section 23 00 00.

B. Submit diagrams indicating mechanical system controlled and control system components. Label with settings, adjustable range of control and limits. Include written description of control sequence.

C. Include flow diagrams for each control system, graphically depicting control logic.

D. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

1.05 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 23 00 00.

B. Accurately record actual setpoints and settings of controls, including changes to sequences made after submission of shop drawings.

PART 2 - PRODUCTS

2.01 TEMPERATURE CONTROL COMPONENT

A. Temperature controls contractor shall provide all necessary system components (i.e. thermostats, valves, dampers, actuators, transformers, relays, control wiring and tubing, etc.) for a complete operable system.

PART 3 – EXECUTION

3.01 FAN COIL UNITS (FC)

A. Single zone fan coil units. Modulating hydronic heating coil & Modulating hydronic cooling coil controlled by a Space Sensor.

1. Occupied Cycle:

   a. The supply fan shall be continuous air flow. Flow shall be modulated based on deviation from setpoint from 50% to 100%. The 3-way hydronic heating and cooling valve shall modulate to maintain a proper discharge air temperature for space set point. O.A. shall enter the space though the ERV unit.

   b. As space temperature rises above set point (cooling mode) or falls below setpoint (heating mode), the FC shall have the cooling and heating valves modulate to maintain setpoint.

   c. Space set point shall be established by a space sensor interconnected to the DDC control system and limited by system with visual display and occupant adjustment buttons.

2. Unoccupied cycle (public spaces):

   During the unoccupied cycle, the space sensor shall modulate the control valves (heating and cooling) and modulate the supply fan.

3.02 ENERGY RECOVERY VENTILATOR UNITS (ERV-1, 2 & 3)

A. Building ventilator Units – 0 or 100% outside air, as controlled by a schedule.

1. Occupied Cycle:

   a. The supply fan and exhaust fans shall run continuously. The fans shall run at full air flow according to a schedule.

   b. A photoelectric or ionization type duct smoke detector with manual reset shall be installed and located in the supply air of all units with an air flow of 2000 CFM or greater. The Mechanical Contractor shall wire the detector to stop the supply fan and stop the exhaust fan damper when smoke is detected.

2. Non Running cycle: (demand control)

Units to have integrated into there programming an unoccupied cycle, the exhaust and make up air fans shall not run, the space sensors shall cycle the supply fan and modulate the heating and cooling stages to maintain temp. It shall be possible to return the unit to the occupied mode by overriding the sensor program. The reset shall automatically return to its normal position at the beginning of the next automatic control cycle. Heating shall be by the in-floor.

3.08 HEATING / COOLING CIRCULATING PUMPS

A. Heating/ Cooling pumps are to be activated automatically and to operate continuously based on the season. Season shall be determined by an outside air sensor.

3.09 CABINET UNIT HEATERS

A. The room sensor will cycle the unit fan motor to maintain room temperature based on an established setpoint temperature.

B. Below the setting of the aquastat, the unit fan will not run.

3.13 HEATING SYSTEM BOILERS- (B-1 & B-2)

A. Boilers (B-1 & B-2) shall be enabled/disabeled by the Boilers controls. The boilers shall have there water temperature controlled to maintain the set points and be reset on OA temp.

B. Boilers shall comply with CSD-1 requirements.

3. 13 FLUID COOLER

A. The Fluid Cooler shall have a VFD driven motor/fan which shall modulate based on demand.

B. The Adiabatic spray system shall modulate based on demand.

C. Enthalpic sensors shall measure temp and humidity for in coming and out going air for the Fluid cooler.

3.14 AIR TO AIR HP UNITS

A. The units for each unit shall cycle its compressors according to demand.

END OF SECTION 25 51 00
SEQUENCE OF OPERATION

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SECTION 26 00 00

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Labor, materials, equipment, tools supervision & start-up services.

B. Electrical building system closeout.

1.02 SECTION INCLUDES

SECTION 26 00 00	ELECTRICAL GENERAL PROVISIONS
SECTION 26 01 26	TESTING
SECTION 26 05 00	BASIC ELECTRICAL MATERIALS AND METHODS
SECTION 26 05 26	GROUNDING
SECTION 26 06 20	PANEL BOARDS
SECTION 26 10 00	SERVICE AND DISTRIBUTION
SECTION 26 32 13	GENERATOR SYSTEM
SECTION 26 36 23	AUTOMATIC TRANSFER SWITCH
SECTION 28 31 00	FIRE ALARM AND SMOKE DETECTION SYSTEM

1.02 COORDINATION OF ELECTRICAL WORK

A. Responsibility:

1. The Electrical Contractor shall be responsible for his Sub-Contractors and Suppliers, and include in his bid materials, labor, and equipment involved, and install in accordance with local customs, codes, rules, regulations, jurisdictional awards, and decisions; and secure compliance of parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.

2. The Electrical Contractor and Sub-Contractor(s) shall be responsible for tasks applicable to his trade, as directed by the General Contractor, in accordance with the Specifications, Drawings, code requirements and shall be responsible for coordinating locations and arrangements of his work with all other relevant Mechanical, Architectural, Structural and Electrical Contractor's Specifications, Drawings and shop drawings. Coordinate work so that sprinkler heads, lights, diffusers, etc. are coordinated into Project and are installed per the architectural reflected ceiling plan.

B. Site and Project Document Examination:

1. Submission of a proposal is considered evidence that the Contractor has visited site and acquainted themselves with all existing conditions, made all necessary measurements, examined the Drawings and Specifications of all trades, including Mechanical, Architectural, Structural, and Electrical, and has fully informed himself with all Project and site conditions, and is proficient, experienced and knowledgeable of all standards, codes, ordinances, permits and regulations which affect the installation of his respective trade, and that all costs are included in his proposal.

2. The Electrical Contractor and/or Sub-Contractor(s) shall obtain all required permits and assessments prior to starting work. Contractor shall verify requirement to include permits as part of his formal bid, as described in the General and Supplementary Requirements.

3. No allowance shall subsequently be made in the Contractor's behalf for extra expense incurred due to failure or neglect on his part to make this site visit and examination.

4. It is the responsibility of the Contractor to notify the Engineer, prior to submitting his bid, of any potential problems that he has identified during his site visit or from examination of the Contract documents.

C. General Supports:

1. Provide all necessary angle, channel, brackets or supplementary steel as required for adequate support for all conduit, specialties and equipment which is hung or mounted above floor. Secure approval from Architect, in writing, before welding or bolting to steel framing or anchoring to concrete structure.

2. Where conduit or equipment is suspended from concrete construction, set approved concrete inserts in formwork to receive hanger rods, such as structural steel channel, and where installed in metal deck use Ramset or welds as required.

D. Equipment Clearance:

1. Electrical Contractor to coordinate with the Architectural and Mechanical trades for equipment locations and to ensure adequate clearance is maintained, as required by the National Electrical Code and applicable state and local codes, as well as accessibility for future maintenance and operation.

2. Electrical work shall be arranged with building construction to provide minimum 6'-8" overhead clearance where possible.

E. Wall, Floor and Ceiling Openings:

1. Locate openings and advise the General Contractor/Construction Manager of details and templates of all openings necessary for inspection of electrical work.

2. In general, openings and required lintels shall be provided through the General Contractor/Construction Manager. Size and location is the responsibility of this Contractor. Cracks and rough edges left following installation of equipment shall be caulked or covered by Electrical Contractor.

3. Openings through drywall or concrete surfaces for supporting electrical equipment, including conduit penetrations, shall be drilled in a neat and work-like manner.

4. Electrical penetration holes through fire rated materials and systems shall be sealed in a manner to maintain the fire rating of that material and system.

5. Foam type sealer shall be used in accordance with the manufacturer's instructions for storage, hole preparation, mixing, and application. Two part foam type fire sealer shall be Dow Corning Silicone RTV, or approved equal.

6. Mechanical type fire stops shall be fitted to the opening and cable sizes, assembled, and installed per the manufacturer's instructions. Stops shall be Crouse-Hinds "TW Series, Thru-Wall-Barrier", Nelson Electric "Multi-Cable Transits", or approved equal.

F. Access Panels:

1. Items of equipment which require accessibility, adjustment, maintenance or observation such as junction boxes, controls, etc., shall be located and arranged for ready access either directly or through the use of access doors.

2. Notify the Engineer and all affected trades where and of what size and/or configuration access doors will be installed. Secure the approval of the Architect/Engineer for these locations and configurations.

3. Such access doors/panels shall meet or exceed the fire barrier rating of the floor, wall or partition into which they are inserted.

4. Access doors or panels, where required, shall be provided by the Contractor or Subcontractor whose equipment requires the access unless otherwise noted. This trade is to coordinate the access panel manufacturers with the architectural access panels.

G. Excavating and Backfilling:

1. Excavation and backfilling shall be performed in accordance with Division 2, Earthwork, and this Section.

2. Respective trades shall provide all trenching, excavating and backfilling as required for the installation of their work, including bracing, shoring and dumping as may be required. Provisions shall be made to ensure the safety of persons and property while work is proceeding as well as when the area is unattended.

3. Excavations shall conform to the required burial depth of equipment designated on the drawings, as required by field conditions, code requirements and as directed by the Engineer.

4. Enclose, support, barricade and mark all excavations as required and as directed by the Architect/Engineer, or Owner's representative.

5. Exercise caution in excavation and personally check with all utilities (Call "Miss Dig") and the Owner for all required information on existing underground work in the area of the excavation. Repair all damage to existing underground work if damage is inflicted in the course of the excavation.

6. Obtain Architect/Engineer's permission, in writing, before any tunneling.

7. Provide separate trenches for each utility unless otherwise noted or directed.

8. Where electrical work is to be installed in filled or disturbed earth, raceways shall be supported by brick piers or other approved supports placed under the raceways and carried down to a firm bearing. All lines shall be laid straight and true alignment with the grade in the location established on the drawings or as directed by the Engineer.

9. Backfill under buildings, sidewalks, drives or parking lots shall be with 100 percent clean, non-cohesive sand. Compaction shall be in accordance with Division 2, Earthwork.

H. General Cleaning:

1. It shall be the responsibility of this Contractor to keep the premises free of accumulations of surplus material or rubbish caused by his operations and/or the operations of his Subcontractors. Combustible rubbish and debris shall be removed immediately. The trades shall remove their rubbish and debris from the project site promptly upon its accumulation.

2. Upon completion of the installation, the Contractor shall thoroughly clean all fixtures, equipment, boxes, raceways, controls, enclosures and other applicable equipment and accessories free of all foreign material.

3. All patching, repairing and painting required of surfaces damaged or allowed to deteriorate in the performance of this work made by this Contractor, where directed by the Architect/Engineer, shall be at this Contractor's expense.

4. If a Contractor does not remove rubbish or clean the systems as specified above, the Owner's representative reserves the right to have the work performed by others, with the cost back-charged to the Contractor who made the removal or cleaning necessary.

I. Field Changes:

1. The Contractor shall not make any field changes that affect timing, costs or performance without written approval from the Architect/Engineer in the form of a Change Order, Field Change Order or a Supplemental Instruction. The Contractor assumes liability for any additional costs for changes made without such instruction or approval. Should any unauthorized change be determined by the Architect/Engineer as lessening the value of the project, a credit will be determined and issued as a change to the contract.

1.03 STANDARDS, CODES AND PERMITS

A. Refer to Division 1, General Requirements and Supplementary Conditions.

B. All work installed under Electrical Sections shall comply with latest edition of applicable standards and codes of the following, including local codes and variances:

ADAG Americans with Disabilities Act Guidelines
AEIC Association of Edison Illuminating Companies
ANSI C2,American National Standards Institute
ANSI C73, Dimensions of Attachment Plugs and Receptacles
ASA American Standards Association
ASTM American Society of Testing Materials
ICEA Insulated Power Cable Engineers Association
IEEE Institute of Electrical and Electronics Engineers
OSHA Occupational Safety and Health Act
NEC Latest edition of (NFPA 70) as approved by the local authority having jurisdiction
NECA Standards for Installation
NEMA National Electric Manufacturers Association
NESC National Electric Safety Code (H13)

NETA National Electrical Testing Association, Inc.
NFPA National Fire Protection Association
UL Underwriter's Laboratories
Regulations of the local power utility company.

C. Work shall be provided and tested in accordance with all applicable local, county, state laws, governmental ordinances, codes, rules and regulations.

D. Contractor shall give all notices, file all drawings, obtain necessary approvals, obtain all permits, pay all fees, deposit and expenses required for installation of all work under this Contract.

E. No work shall be covered or enclosed until work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority.

F. In general, material where applicable shall be labeled or listed by Underwriters' Laboratories, Inc. Assembled electrical equipment supplied to the job site shall be listed or labeled and/or approved by the authority having jurisdiction.

G. In the event plans and specifications conflict with any rules, regulations or codes applying, said rules, regulations and codes shall govern the Contractor.

1.04 SUBMITTALS

A. Shop Drawings:

1. After a schedule of Sub-Contractors is approved by the Engineer, submit eight (8) neatly bound copies of shop drawings (or number as directed by General Requirements) with one device or fixture of each type clearly identified (high-lighted, bolded, underlined, etc.) in each set on equipment and materials indicated on drawings or in the specifications.

2. Submit complete manufacturer's shop drawings of equipment, accessories and controls, including dimensions, weights, capacities, construction details, installation, control methods, wiring diagrams, and motor data, etc.

3. Engineer's approval of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving Contractor of basic responsibilities under Contract Documents, and does not approve changes in time or cost.

4. After approval, each Contractor is responsible to provide information to other trades involved in, or affected by, installation of his equipment and work.

B. Operating and Maintenance Instructions and Manuals:

1. Electrical Contractor shall provide for all major items of equipment two (2) bound and indexed sets of operating/installation and maintenance instructions to Engineer for approval. After approval, manuals will be given to Owner by Engineer.

2. Manuals shall include a complete set of shop drawings submitted, indexed with tabs for each section.

1.05 ELECTRICAL SERVICE REQUIREMENTS

A. Electrical Contractor shall verify with the Utility Company the electrical system amperage, voltage and phase and report any variation from what is indicated on the drawings to the Engineer. Electrical Contractor shall obtain written verification of the available symmetrical and asymmetrical RMS fault current from the Utility Company and submit to the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standards:

1. Products shall be of established manufacturers regularly engaged in making type of materials to be provided and complete with all parts, accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

B. Substitution and Changes:

1. Contractor and/or Equipment Supplier may propose alternate equipment or materials of equal quality, function, durability and appearance as described and permitted in Specification Section 16000, 1.01.B. The substitution will take the form of an "Add-Deduct" to the bid proposal. It is the submitter's responsibility to provide sufficient material for review as required by Engineer's office. Acceptance and approval is the responsibility of the Engineer.

2. No substitutions will be accepted, except as authorized in a Project Addendum.

3. Contractor and/or Equipment Supplier is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product not named as the basis of design is used and the Contractor is responsible for advising other Contractors of variations and, if requested, submit revised drawing layout for approval by the Engineer.

C. Explanation of Scheduled Manufacturers:

1. “Base Bid”. This term designates that this equipment will be the product which the contractor generates his bid from. It is usually a component that is critical to maintaining the design intent. No other equipment suppliers will be allowed to bid as an “equal”.

2. “Based On”. This term designates that the equipment is designed around a certain product. Products of equal status are listed and may be bid as if they were the basis of design. The “based on” equipment shall serve as the standard to which equals will be judged.

2.02 EQUIPMENT REQUIREMENTS AND CONNECTIONS

A. Motor Starters and Controls:

1. Electrical Contractor shall provide manual or magnetic motor starters as required for motors not provided by Mechanical Trades and as indicated on Electrical Drawings and as specified within this Specification.

2. Mechanical Contractor shall provide factory installed motor starters integral with packaged equipment containing thermal overcurrent protection in ungrounded conductors with heater coils selected for specific motor usage for motors, unless otherwise shown on electrical drawings.

B. Electrical Wiring and Controls:

1. Mechanical Contractor shall provide motors, drives, controllers and safety switches integral to packaged equipment and factory mounted controls for mechanical equipment as indicated. When pre-wired equipment is used, control circuit shall be separately fused at control transformer and shall always revert to a fail-safe condition.

2. Mechanical Contractor or Temperature Control Contractor shall provide electrical devices requiring mechanical connections, and/or electrical connections, such as pressure switches, limit switches, float switches, solenoid valves, motor operated valves, motor operated dampers, fire stats, freeze stats, thermostats, override timers, E.P.'s, P.E.'s, temperature control cabinet, etc.

3. Mechanical Contractor or Temperature Control Contractor shall provide Class 2 and 3 wiring, conduit, boxes for their associated equipment unless otherwise noted.

   Electrical subcontractor shall furnish and wire duct type smoke detectors. Duct type smoke detectors shall be installed by Mechanical Trades.

4. Electrical Contractor shall install power wiring and conduit to motors and/or factory mounted control panels as indicated on Drawings or as indicated in other sections of the Specifications.

5. Electrical wiring work by Mechanical Contractor and Temperature Control Contractor shall be in accordance with Division 16 requirements.

C. Owner Supplied Equipment:

1. Electrical Contractor is to provide power wiring, conduit, starters and safety switches on equipment as indicated on the drawings. Make final power connections to equipment. Any control wiring or remote power supplied by the equipment to remote units shall be provided by the Owner.

PART 3 - EXECUTION

3.01 CLOSEOUT

A. Final Acceptance:

Final acceptance and payment will only be made after final punch list completion and receipt at Engineer's office of:

Certificates of Inspection
Test Reports
Guarantees/Warranties

Record Drawings (As-Builts)
Operating and Maintenance Instruction Manuals (2)

B. Certificates of Inspection and Test Reports:

The Contractor shall submit to the Engineer's Office evidence that installation has been inspected and approved by municipal or state electrical inspector and/or the authority having jurisdiction.

C. Guarantees and Warranties:

1. During the one year period of continuous operation (except if General Requirements specify a longer warranty period), make two complete inspections (one at 3 months and one at 6 months) of all systems, fixtures, equipment, safety devices and controls to ensure equipment operating properly, and report to Engineer in writing. Contact the Owner's Operation/Maintenance Supervisor to schedule site inspection.

D. Record Drawings:

1. Maintain a white-print set of Electrical Contract Drawings in clean, undamaged condition for mark-up of actual installation on Electrical Contract Drawings which vary substantially from the work as shown. These drawings are to be available for inspection by the Engineer on a weekly basis.

2. Submit as-built record drawings consisting of separate plans and riser diagrams for following systems:

Power
Lighting and Controls
Fire Alarm/Life Safety System

Each system drawing shall show location, size and conductor fill for conduits, junction boxes and outlets. Specification changes shall also be submitted.

E. Operating and Maintenance Instructions:

1. Provide instruction of Owner's personnel in operation and maintenance procedures for all systems equipment.

F. Placing Systems into Operation:

1. Electrical Contractor shall be responsible for all start-up procedures, system checks and balancing associated with his equipment.

2. Equipment shall be installed, tested and operated in accordance with manufacturer's recommendations at normal operating conditions.

3. Permanent electrical equipment operated during construction periods shall be cleaned, and damaged equipment replaced.

G. Adjustments and Balancing:

1. Subsequent to beginning operation of the electrical power and distribution systems, the Contractor shall make all necessary adjustments to equipment installed or

connected by him under this contract so as to ensure proper operation of the same. The Contractor shall measure, phase balance and make necessary adjustments to any portion of the electrical system that is substantially out of balance.

3.02 GUARANTEES AND WARRANTIES

A. Labor, materials and equipment shall be guaranteed by Contractor and/or warranted by manufacturer for one year after acceptance date and/or one normal continuous complete season's operation applicable to equipment or system except where specified longer for special equipment. Contractor shall secure such warranty from Suppliers (not one year from shipment date), or Contractor to assume warranty.

B. Acceptance date of substantial completion shall be Owner occupancy as determined by Architect/Engineer.

C. Contractor shall make necessary alterations, repairs, adjustments, replacements during guarantee periods as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner.

D. Repair or replacements made under guarantee bear further one year guarantee from date of acceptance of repair or replacement.

END OF SECTION 26 00 00
ELECTRICAL GENERAL PROVISIONS

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SECTION 26 01 26

TESTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this section. The General Requirements apply to the work of this section.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. Test all circuits as soon as conductors are installed and make final tests when all work is complete. If circuits are not properly controlled and insulated at time of such final tests, the necessary extra repairs and tests shall be made at the Contractor's expense.

B. All 240 and 208 volt wiring systems, sizes No. 4 AWG and larger, shall be given an insulation resistance test between conductors and between a single conductor and ground. Resistance shall not be less than 40 megohms. Measurements shall be made with all panelboards, overcurrent devices, etc., in place, and with circuit breakers or disconnect switches in the open position.

C. Lighting and control wiring shall be tested for shorts or opens and shall be given a complete operational test.

D. After installation is complete and properly adjusted, the various equipments and systems shall be demonstrated to operate in accordance with the requirements of the drawings and specifications.

E. Tests, inspections and work shall be performed in the presence of and approved by the Owner's Representative before energizing the system.

F. Power circuit breaker shall be tested and calibrated with results entered in the forms specified.

G. Circuit breakers, including those equipped with static trip units, shall be tested by the use of a "Multi-Amp" or similar piece of equipment. Long-time delays shall be tested by placing three times the rated current of the trip unit through the breaker. Instantaneous tripping shall be tested by placing the full value of current through the breaker. Lesser amounts of current with "artificial" tripping will not be permitted.

3.02 FIRE ALARM AND SMOKE DETECTION SYSTEM (For Smoke System as required for Sprinkler sys)

A. Include services of a manufacturer's certified representative to provide final testing, adjusting, and commissioning and instructing the Owner's Representative in the operation and maintenance of the system as listed herein.

B. Test heads by using manufacturer's recommended detector tester with halogenated type gas and sensitivity tester when adjustable detectors are used. The manufacturer's certified technician shall evaluate the installation and operation of the system.

C. Submit eight copies of test and evaluation reports to the Architect/Engineer.

D. Control wiring shall be tested for shorts or opens and system shall be given a complete operational test.

E. After installation and adjusting the Smoke Detection System, the various equipment and systems shall be demonstrated to operate in accordance with the requirements of the drawings and specifications.

F. The whole system shall be tested and left in operating conditions. Testing shall be performed as directed by the Owner or Owner's Representative. Final test and inspection shall be performed with the Fire Marshall's Representative and Electrical Inspection Bureau Representative and done during Owner's normal working hours.

G. The Contractor or its representative and the equipment manufacturer's representative shall be present at all inspections and be prepared to perform certain test functions and answer questions related to the equipment.

H. Noise test shall be performed by the Contractor to ensure that the audible sound is heard everywhere and of a level acceptable to the Fire Marshall's Office. If the Fire Marshall’s Office indicates that the sound level is too low from a device, the contractor shall replace the device at no cost to the owner.

END OF SECTION 26 01 26
TESTING

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SECTION 26 05 00

BASIC ELECTRICAL MATERIALS & METHODS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Shop drawing submittals

B. Raceways, wire & cables, outlet boxes, wiring devices, motor starters & panels.

C. Installation methods

1.02 IDENTIFICATION

A. Service switches, motor disconnects, controllers, etc., whether or not furnished under this Division shall be marked to identify the equipment served and the origin of the power source. Branch panelboards, distribution panels, transformers, and switchboards shall be identified as to designation and voltage characteristics. **All identification shall be done with engraved plastic plates, black with white letters**.

1.03 DIRECTORIES

A. **Provide each panel with a typewritten index**. Insert index into a transparent plastic holder secured to the inside of the panel door.

1.04 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings for the following:

a. Wiring Devices and Switches.
b. Specialty Wiring Devices.
c. Starters.
d. Panel boards.
e. Safety Switches.
f. Transient Voltage Surge Suppression.
g. Lighting fixtures and controls.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Wiring shall be installed in approved raceways where required by code and be a minimum size of 3/4" for homeruns unless otherwise noted. 1/2" conduit will be permitted for switch and receptacle runs in walls. Conduit or tubing shall be installed in a manner which complies with all applicable provisions of the National Electrical Code.

B. Ends of conduit or tubing shall terminate in a bushing or fitting having factory installed insulating liners. Provide plastic bushings on conduit or tubing with wire larger than #4

AWG. Exposed runs shall be supported by hangers, clamps, or straps secured by toggle bolts in hollow construction or expansion bolts or inserts in poured or brick walls.

C. Every precaution shall be taken to protect the conduit from damage and from water, dirt, concrete, etc., getting into the system during construction. Capped bushings shall be used on conduit terminations until wire is installed. If, in the opinion of the Engineer, conduit or tubing has become damaged or contains unremovable foreign matter, it shall be replaced at the Contractor's expense. Aluminum conduit is not acceptable in this contract.

D. Intermediate metallic conduit (IMC) shall be hot dipped galvanized steel, and shall be used on all runs above 2-1/2" unless otherwise noted. Intermediate metallic conduit may be used in all poured construction, fill, outside masonry walls, areas exposed to weather, under drives and walks, and in areas where tubing may become damaged.

E. Cast and threaded fittings for IMC shall be used on exposed conduit installed on walls below 8"-0" and on conduit exposed to weather.

F. Plastic conduit shall be high strength smooth inner with polyvinyl chloride, heavy wall type equal to Carlon Schedule 40 for use as direct burial without concrete encasement, except as required by code. Couplings shall be the solvent welded type. Circuits run in PVC conduit require a separate grounding conductor.

G. Electric-metallic-tubing (thinwall conduit) shall be standard weight with manufacturer's name and Underwriters' Label on each length. Maximum permissible size tubing shall be 2-1/2".

H. Tubing may be used for feeders and branch circuits above suspended accessible ceilings; for switch and receptacle legs which terminate above suspended accessible ceilings and for exposed feeders and branch circuits.

I. Metal conduit and EMT fittings should be galvanized malleable iron, steel, aluminum, or zinc die-cast. Connectors and couplings shall be threaded, set-screw, or compression type, and concrete-tight and/or rain-tight where required. Conduit bodies shall be malleable iron or aluminum cover gaskets exposed to weather.

1. Expansion Fittings: cast or malleable iron bodies, with threaded end caps for receiving fixed and moveable conduits, metallic pressure packing, and copper bonding jumper assembly. Fittings shall provide for minimum 2" of movement of conduit in either direction. Fittings shall be Appleton type "XJ" or similar fittings by another approved manufacturer.

2. Expansion-Deflection Fittings: neoprene sleeve secured to silicon bronze threaded couplings by means of stainless steel bands. Fitting shall be designed to provide for movement of not less than 3/4" from normal in all directions and shall be complete with tinned flexible copper braid bonding jumper protected by neoprene sleeve and securely bolted to couplings for grounding continuity through joint. Fittings shall be O.Z./Gedney Electric Company, type "DX" or similar fittings by another approved manufacturer.

3. Locknuts: malleable iron or steel. Bushings shall be malleable iron or steel, or plastic. Malleable iron or steel bushings shall be zinc or cadmium plated and shall have insulating insert of thermosetting plastic molded and locked into bushing ring. Plastic bushings shall be thermosetting phenolic insulating type conforming to Federal

Specification W-F-406 and Amendment 6. Use of non-rigid plastic bushings is prohibited.

J. Flexible metal conduit shall be used for connections to the following equipment: Motors and mechanical equipment. Maximum length of flexible metallic conduit shall be 6'-0". Minimum size shall be 1/2". Flexible metal conduit used for lighting fixture connections shall be "Greenfield" type. Fittings shall be insulated throat, flex-steel connectors. Flexible metal conduit used for equipment other than lighting fixtures shall be similar to "Greenfield" except jacketed with a plastic outer cover and terminated with appropriate factory-installed fittings, UL Labeled.

K. Flexible metallic conduit shall have separate grounding conductor.

L. Space around conduits at wall penetrations shall be filled with mortar, or other approved filler, maintaining the rating of wall/ceiling construction as required.

2.02 WIRES AND CABLES

A. Wiring:
   1. Shall be THHN stranded copper, single conductor, and shall be installed in conduit or tubing unless specified otherwise (areas required: garage, mechanical & electrical rooms and exterior).
   2. May be aluminum SER cable, single conductor, and shall be installed in conduit or tubing unless specified otherwise (areas required: garage, mechanical & electrical rooms and exterior. Primary feeders and sub-panel feeders only.

B. Romex shall be acceptable in wood frame construction as directed by NEC.

C. M.C. Cable shall be acceptable in steel stud construction as directed by NEC.

D. Conductors shall be continuous between outlets or junction boxes with splice made only within such boxes.

E. No wire smaller than #12 may be used unless specified under descriptions of special systems. Control wiring may be #14 AWG or smaller as indicated, and shall be stranded.

E. Cables for smoke detection systems or for use in plenums without conduit shall be UL listed, UL Style 1330, meeting ASTM D-2116 and ICEA color codes.

F. Wire for general interior, exterior, and control use, sizes #14 AWG through 500 MCM, shall be single conductor, insulated for a minimum of 75 degrees C, THHN, THWN, or XHHW, elsewhere, and be rated 600 volts. Where required ampacities can only be satisfied by conductor sizes larger than 500 MCM, parallel conductors shall be used.

G. Wire for final connection at HID and incandescent lighting fixture sockets shall be NEC type SF-2 fixture wire rated 200 degrees C, 600 volts.

H. Wire for use in fluorescent fixture wiring channels shall conform to NEC Types THHN or XHHW, rated 90 degrees C, 600 volts.

I. Ground wire for interior use shall be green insulated, stranded copper. and shall meet requirements of wire for general interior use.

J. Branch circuit wiring shall be color coded, red, black, blue for phase wiring, and white neutral. Bonding conductors shall be green or bare. Phase color coding shall be consistent throughout the entire branch circuit system.

K. All neutral runs including feeders shall be white full length of conductor.

2.03 WIRE CONNECTORS AND JOINTS

A. Conductors #6 AWG and smaller shall be joined with electrical spring connectors with vinyl insulating cap. Conductors larger than #6 shall be joined by compression type connectors.

2.04 OUTLET BOXES

A. A standard galvanized or plastic outlet box shall be installed for each and every outlet shown.

B. Set boxes squarely with faces flush to finished surfaces. The exact location of all outlets shall be approved by the Architect/Engineer before same are placed and Contractor shall consult Architect/Engineer at all times relative to the location of outlets. No outlets shall be placed behind plumbing or heating pipes or where they will interfere with ducts, pipes, equipment, or other work. Outlets not located in accordance with these instructions shall be relocated when so directed by the Architect or General Contractor by this Contractor at his expense including cost of any cutting and patching the work of other trades as may be required by such relocation.

C. Each outlet shall be rigidly supported from the building construction (independent of the raceway system).

D. Ceiling outlet boxes shall be 4" octagon, minimum 1-1/2" deep, with fixture hickey, and supported to withstand 80 pounds.

E. Convenience outlet and switch boxes shall be a minimum of 2-1/8" deep. When installed in poured walls, 2-1/2" minimum deep box shall be used; when installed in masonry, 3-1/2" minimum deep box shall be used.

2.05 JUNCTION BOXES AND PULL BOXES

A. When used, pull boxes and junction boxes shall be galvanized and have flat steel covers fastened with screws and set flush with the finished surface and located in an accessible area. When installed in damp locations, gaskets and seals shall be provided. Junction boxes shall be sized to meet N.E.C. Standards based on conduit and conductors. Provide identifying labels on each box.

2.06 WIRING DEVICES

A. Receptacles

1. Receptacles shall be mounted approximately 1'-4" above floor to bottom or at other heights indicated on Drawings.

2. Contractor shall be responsible for masking receptacles for protection from painting, plastering, etc.

3. Receptacles shall be commercial specification grade as manufactured by Hubbell, Leviton, or General Electric.

   a. 20 Amp, 125 Volt, duplex, ground fault, (NEMA 5-20R), Hubbell GF-5352-W series, with #CWP26H outdoor weatherproof cover for exterior use.

   b. 20 Amp, 125 Volt, duplex (NEMA 5-20R), Hubbell CBR20W series.

   c. 20 Amp, 125 Volt, duplex with isolated ground (NEMA 5-20R), Hubbell IG5362 series.

   d. 30 Amp, 125/250 Volt (NEMA 10-30R), Hubbell 9350 series.

   e. 50 Amp, 125/250 Volt (NEMA 10-50R), Hubbell 7962 series.

   NOTE: GFCI receptacles must meet UL 2003 Standards.

B. Wall Switches

1. Wall switches shall be mounted approximately 4'-0" above floor to top unless they interfere with wainscoting or trim. Switches shall be commercial specification grade, totally enclosed molded composition, silent type, spring action silver contacts, and rated at 120/277 volts A.C. Switches shall be binding screw type, side and back wired type.

2. Contractor shall be responsible for masking switches for protection from painting, plastering, etc.

3. Contractor shall confirm door swings with Building Trades Contractor before installing switches.

4. Switches shall be rated at 20 Amp, white in color, Hubbell CSB120 series, Leviton, or General Electric., or P & S switches of equivalent grade or as noted on construction drawings. Switches shall be single pole, double pole, three-way, keyed (master), or other type as indicated.

C. Wall Plates

1. Wall plates shall be installed plumb and level with all edges in contact with attaching surface. **Plates shall be brushed smooth stainless steel**. Provide blank cover plates for all data and telephone outlet boxes shown on plans. Plates used on exposed surface mounted outlets shall be the raised pressed metal type, stainless steel finish, to accommodate the device and cover the outlet box, without fillers of any kind. Mounting screws shall be metal with same finish as plate and with countersunk head. Plates shall be single, ganged, or combination, to accommodate arrangement indicated on drawings. Arrow-Hart, Leviton, General Electric, Hubbell, or P & S plates of equivalent grade will be acceptable.

2.07 SPECIALTY WIRING DEVICES

A. Thermostat/Sensors:
For each of the thermostats/sensors shown, a single gang box with a 1/2" conduit in new areas, or a single gang box with wiremold (to match existing) in existing areas, stubbed to

the unit being controlled. Up to accessible ceiling or from controller to unit in non-accessible ceilings. Box mounted at 44" A.F.F.

B. Smoke Sensors for HVAC units 2000 cfm or more (Reference Mech. Plans):
It shall be required that the E.C. provide and install the necessary code required alarming/signaling equipment as related to the smoke sensors for HVAC units 2000 Cfm or more.

2.08 MAGNETIC STARTERS - COMBINATION TYPE; THREE-PHASE MOTORS

A. In general, the magnetic starters shall be of the minimum NEMA 0, combination type consisting of a circuit protective device, switch and fuse type, and a NEMA size starter as required. Circuit protective device shall be a fused type "A" safety switch. The motor starter shall comprise of NEMA size contactors, overload relays, heaters, interlocks, etc. The hinged cover shall be so interlocked that it may not be opened when the switch is in the "ON" position, except that the interlock shall be tool-releasable by a qualified person. Starters shall have provisions for padlock. The motor starter shall include phase loss and phase unbalance protection, or auxiliary devices shall be installed to accommodate these types of protection.

B. Each combination starter unit shall be furnished with HAND-OFF-AUTO selector switch, green running light, and with individual control transformers, with fused secondary, rated 120 volts. Starters shall be supplied with two N.O. contact.

C. Starters shall be by Square D. General Electric or Cutler Hammer maybe bid as alternates.

2.10 SINGLE PHASE MOTOR STARTERS

A. Manual starters for fractional horsepower single phase motors shall be single or double pole with pilot lights and thermal overload relay elements. Enclosure shall be NEMA 1, surface or flush mounted as indicated with provision for padlocking unless described otherwise on drawings. Thermal overload elements shall be sized on basis of motor rating and starter manufacturer's instructions. Units shall be General Electric "Type CR-101," Square D "Class 2510," or Cutler Hammer.

2.11 FUSESTATS

A. Fusestats shall provide overload protection and may be used for permanently wired motors rated up to 1/2 HP, 125 Volt A.C. only.

B. Fusestat base shall be constructed of pre-galvanized steel plate with a hood of galvanized steel and fit on a standard double gang 4" square box.

C. Fusestat shall consist of a fused outlet and switch and be by Steel City, Catalog No. F8-S, or equal by other approved manufacturer.

2.12 PANELBOARDS

A. Panelboards shall be of the circuit breaker type with main lugs or main breaker as indicated on Drawings. Use full size plug-in/bolt-on type branch circuit breakers (tandem type are not permitted). Branch circuit breakers shall be rated a minimum 10,000 amperes interrupting capacity symmetrical. The capacity shall be determined by the job

conditions. It is the installing contractor's responsibility to guaranty that the requirements are met.

B. Branch circuit panelboards shall be Square "D" type QO 'Load Center', NQOD, NF, I-line. General Electric or Cutler Hammer, may submit voluntary alternates of equal quality. All panels shall meet Federal Specifications W-P-115A.

2.13 FUSES

A. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, one-time fuse, 250 or 600 volt as required, UL Class J.

B. Interrupting Rating: 200,000 rms amperes.

2.14 SAFETY SWITCHES

A. Furnish and install required safety switches.

B. Safety switches shall be NEMA heavy duty type "HD", fusible or non-fusible as indicated, and Underwriter's Laboratory approved. Switches shall be furnished in NEMA-1 enclosures unless otherwise shown on drawings. Weatherproof switches shall be NEMA-3R (raintight).

C. Switches shall be Square D, or equal by General Electric or Cutler Hammer.

2.15 SUPPORTS AND HANGERS

A. Provide and install necessary steel brackets, rods, clamps, etc., for support of work under this contract. Supports shall be plated or painted and shall be secured to structural members after Architect's approval.

2.16 SLEEVES AND INSERTS

A. This Contractor shall be responsible for the proper location on all sleeves, chases, openings and inserts for the installation of his equipment.

B. Holes through walls, floors, or structural members for electrical conduit and equipment shall be drilled in a work-like manner and be located only where permitted by the Architect or Engineer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Conduits shall be cut, bent, joined, and installed per manufacturer's instructions, U.L. General Information, and the N.E.C.

B. Outdoor and underground encased coupling and conduit threads shall be treated with mastic or similar compound to prevent entry of water.

3.02 INSTALLATION METHODS

A. Conduit runs shall be placed neatly and orderly at parallel or perpendicular lines to building walls.

B. Conduit runs parallel to or crossing uninsulated hot water or steam pipes shall be separated from same by 12" if parallel, or 7" if crossing. Where hot water or steam pipe lines are insulated, conduit shall clear insulation surface by 2". Conduits shall not be installed directly under cold water pipes.

C. No more than two concealed conduits shall cross over at same point in a poured slab.

D. Conduit and pull boxes shall be installed mechanically secure to permit pulling in or pulling out of cable proposed for same. Double locknuts and bushing shall be used for termination of conduit at boxes and equipment.

E. Joints of conduits shall be tight, low resistance connections.

F. **A #6 pullcord shall be provided for new empty conduits**. Pullcord shall be wax impregnated, nylon, or other synthetic material resistant to moisture and mildew to prevent deterioration.

3.03 FAULT CURRENT REQUIREMENTS

A. Every effort shall be made by the installing contractor to guaranty that all distribution panels, panelboards and safety switches will be able to safely clear (interrupt) the amount of short circuit amps that could flow on a bolted phase to phase fault.

B. All stated fault currents within the bid documents shall be verified to be correct by the installing contractor.

C. If an error is found in the fault current stated, the contractor shall install the proper devices to maintain required levels.

END OF SECTION 26 05 00
BASIC ELECTRICAL MATERIALS & METHODS

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SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.01 SCOPE

A. The grounding system shall be in accordance with the drawings, specifications and with the National Electrical Code, NEMA, USASI and IEEE Standards, latest editions, where these standards apply. The ground bar of the main service disconnect enclosure shall be bonded to water mains, structural steel, and driven ground rods, by grounding electrode conductor, and as indicated on the drawings. Methods in accordance with good accepted practice for this type of work which cover conditions not indicated on the drawings or described in these specifications and which meet with the approval of the Engineer shall be used in order to secure a good substantial and permanent grounding system. Maximum ground resistance to be per N.E.C.

B. All interconnections, risers, cables, etc. shall be provided and installed for grounding transformers, main switchboard, panelboards and other equipment. Bonding jumpers shall be copper, equal in cross section to the corresponding ground connectors and attached by solder less lugs, compression connections, or clamps. All ground connectors shall have brazed connections, unless otherwise indicated, such as Cadwell, Burndy, Thomas and Betts or equal as approved.

C. Ground cables shall be protected by sleeves where the cable extends through a concrete surface. Ground inserts shall be used where ground cables extending through the surface would be exposed to mechanical damage during or after construction.

D. Where ground cables are installed in rigid metal conduit, the cables shall be bonded to the conduit at both ends of the run.

E. Welds on ground cables shall be cleaned and painted with an asphalt base paint where buried underground or imbedded in concrete.

F. Miscellaneous and special systems shall be properly grounded in accordance with the requirements of each system.

1.02 BRANCH CIRCUIT GROUND WIRE (NEW CIRCUITS ONLY)

A. Provide a #12AWG green grounding wire in each conduit in addition to the circuit wires (phase and neutral wires). The grounding wire shall be connected to grounding terminal bars (to be furnished with each distribution panel) in panelboards, and these bars shall be grounded to the system master ground at switchboard.

B. All equipment, fixtures, receptacles, etc. shall be grounded by means of a separate green ground wire. These wires shall be connected to the respective distribution panel grounding bar, equipped with the required quantity of screw terminals.

C. All isolated ground receptacles require a separate #12AWG ground wire from the receptacle to the isolated ground bus within the panel.

D. Circuits run in PVC conduit will require a separate grounding conductor, provided and installed at no additional cost.

E. All isolated ground circuits shall be connected to a separate ground bar. A separate ground conductor shall be installed for the additional ground bar and be grounded by a separate method from the panel grounding bar.

END OF SECTION 26 05 26
GROUNDING

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SECTION 26 06 20

PANEL BOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this section. The General Requirements apply to the work of this section.

1.02 QUALITY ASSURANCE

A. Panelboards shall be UL label and nameplate, and shall conform to latest NEMA and NEC standards.

PART 2 - PRODUCTS

2.01 PANELBOARDS

A. Panelboards shall be factory assembled and conform to following:

1. Flush or surface mounted galvanized steel cabinet as indicated.
2. Hinged and lockable door with trims on circuit breaker panelboards.
3. Individual hinged and lockable doors on fusible type power distribution panelboards.
4. Locks keyed alike.
5. Manufacturer's standard prime paint and factory finish.
6. Heavy plastic covered typewritten directories.
7. Voltage, phase and capacity as indicated on schedules.
8. Internal assembly of circuit breakers or switch and fuse units as indicated.
9. Circuit breakers and switch and fuse characteristics as specified.
10. Ground fault circuit interrupter type circuit breakers where indicated on the panelboard schedules.
11. Approved terminal grounding bar for general branch circuit equipment grounding conductors.
12. Approved isolated grounding bar for isolated ground receptacle grounding conductors.
13. Interrupting capacity of a minimum 10,000 A.I.C. (amperes rms symmetrical) for branch circuit breakers and a minimum 22,000 A.I.C. for main breakers in distribution or branch panelboards as indicated.

14. Panelboards used for service entrance shall be so labeled and listed for such use and shall have separately barriered provisions for connection of emergency circuit loads. Non-linear load type panels shall be required for designated computer equipment panels.

15. Panelboards shall be by Square D, type QO 'Load Center', NQO, I-Line.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Practice of drilling and tapping or drilling and using self-tapping fasteners in aluminum conductor bars for making electrical or mechanical support connections is prohibited in panelboard construction. Connections may be made by use of through-bolts with lock washers, Belleville washers, steel nuts or steel inserts. Steel helical inserts are not acceptable.

B. Manufacturers who cannot or prefer not to use such methods, shall provide copper bus bars. Copper shall also be provided where required by local or state ordinances.

END OF SECTION 26 06 20
PANEL BOARDS

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SECTION 26 10 00

SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Applicable provisions of Bidding Requirements, Project Guidelines and General Requirements (Division 1) apply to the work specified in this Section.

1.02 DESCRIPTION

A. Work Included:
   1. This Section includes all labor, materials, equipment, tools, supervision, start-up services and Owner's instructions, including all incidental and related items necessary to complete installation and successfully test, start-up and operate in a practical and efficient manner all services and distribution work indicated on the drawings.

   2. In general, this shall include, but not be limited to:
      a. Temporary Power
      b. Service
      c. Distribution

B. Related Work:
   1. The applicable requirements from other Sections for related work shall form a part of the service and distribution work and this Contractor shall consult them in detail for general and specific requirements.

C. Quality Assurance:
   1. Qualifications:
      a. All service and distribution work shall be performed by licensed electricians.

   2. Installation:
      a. Installation methods shall conform to manufacturer's standards for each piece or item of equipment.

1.03 TEMPORARY POWER

A. General:
   1. The Electrical Contractor is to provide temporary construction power facilities throughout the building(s) for his own use and for other use by the various trades. All enclosed rooms shall be equipped with temporary lighting so that work may proceed. Provide power outlets where requested by the various trades. (Note: This shall not be construed as indicating that the Electrical Contractor is to provide any and all voltages at any and all capacities to run heavy power tools, mixers, electric dryers, etc. Normal, 120/208 volt, single-phase power will be provided.) Comply with OSHA Lighting Standard Subpart D, Rule 1926.56(a) and (b). Provide maintenance service for power and lighting facilities, including lamp replacement, during normal working hours.

B. Extensions and/or Extension Cords:

1. If any Contractor requires an extension cord, it shall be provided by that Contractor. Should he require lighting or power in addition to that described in A above, he shall provide it in order to complete his own work. Such additional loads must be coordinated with the Electrical Contractor so that cables and/or circuits are not overloaded.

C. Temporary Connections:
1. The Electrical Contractor shall provide temporary connections for the testing or operation of permanent or temporary motors, pumps, burners, unit heaters or similar units when temporary heat or ventilation is required during construction.

D. Use of Permanent Lighting System:
1. After the installation of the permanent lighting system, it may be used for construction lighting as required. Refer to Section 260500.

E. Codes:
1. Complete temporary power and lighting distribution system shall be in complete accordance with all applicable codes.

1.04 SERVICE

A. New Electrical Service (See Plans):
1. The building shall be fed by a completely new electrical service as herein described and as shown on the drawings.

2. The Electrical Contractor shall furnish and install a new underground secondary service from the transformer to the new main service distribution panel located the Storage Room #105. Refer to drawings for location and One Line Diagram for size and type.

3. The Electrical Contractor shall furnish and install a new 120/208 volt, three-phase, four-wire service entrance main switchboard. This switchboard shall be located in Storage Room #105. Refer to the One Line Diagram for type and size.

1.05 DISTRIBUTION

A. Distribution System:
1. This Contractor shall furnish and install a new distribution system for the building as shown on the drawings and the One Line Diagram.

2. All feeders shall be run continuously without splices, and be type THHN or THWN, unless otherwise noted.

END OF SECTION 26 10 00
SERVICE AND DISTRIBUTION

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SECTION 26 32 13

ELECTRICAL GENERATION SYSTEMS

PART 1 GENERAL

1.01 SCOPE

A. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic controls.

B. Provide factory test, startup by the manufacturers authorized distributor service personnel, and on-site testing of the system.

C. The generator set manufacturer shall warrant all equipment provided under this section, whether or not is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.02 CODES AND STANDARDS

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.

1. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
2. NFPA37 –
3. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
4. NFPA110 – Emergency and Standby Power Systems.

B. The generator set and supplied accessories shall meet the requirements of the following standards:

1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
2. UL1236 – Battery Chargers
3. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

C. The control system for the generator set shall comply with the following requirements.

1. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
2. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
3. FCC Part 15, Subpart B.
4. UL508. The entire control system of the generator set shall be UL508 listed and labeled.
5. UL1236 –Battery Chargers.

D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.03 ACCEPTABLE MANUFACTURERS

A. Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on microprocessor-based generator sets manufactured by Cummins Power Generation. Equipment by Caterpillar or Kohler that meets the requirement of this specification are acceptable, if approved not less than 2 weeks before scheduled bid date. Proposals must include a line by line compliance statement based on this specification.

B. Equipment vendors bidders shall be the authorized Michigan distributor for the manufacturers equipment. Equipment vendors must have the following distributor support:

C. In house rental generator fleet.

D. Distributor level trained power systems service technicians.

E. Parts on service vehicles, in branch locations and at nationwide warehouse.

F. Response time to project site for distributor power systems service technician of 2 hours.

PART 2 PRODUCTS

2.01 GENERATOR SET

A. Ratings

1. The generator set shall be industrial grade, direct connected, operate at 1800 rpm and at a voltage of: 120/208 Volts AC, Three phase, Four-wire, 60 hertz.
2. The generator set shall be rated at 60kW, standby rating, based on site conditions of: Altitude 800 ft., ambient temperatures up to 104 degrees F
3. The generator set rating shall be based on emergency/standby service.

B. Performance

1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
3. The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

4. Motor starting capability shall be a minimum of 497 kVA. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall be less than 40.

C. Construction

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails
2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

D. Connections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
2. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.
3. Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.02 ENGINE AND ENGINE EQUIPMENT

A. The engine shall be natural gas fueled, radiator and fan cooled. Minimum displacement shall be 6.8L. The horsepower rating of the engine shall be 97.5HP Minimum. Engine RPM shall be 1800, direct-connected to alternator. High speed or gear driven packages do not meet this spec and are not acceptable. Engine/Gen Set accessories and features shall include:

B. Complete engine fuel system, including all pressure regulators, strainers, and control valves. The fuel system shall be plumbed to the generator set skid for ease of site connections to the generator set.

C. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.

D. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the generator air inlet, based on 0.5 in H_2O external static head. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a

controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture. Rotating parts shall be guarded against accidental contact.

E. Electric starter(s) capable of three complete cranking cycles without overheating.

F. Positive displacement, mechanical, full pressure, lubrication oil pump.

G. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

H. Replaceable dry element air cleaner with restriction indicator.

I. Flexible Nat Gas fuel line and fuel strainer shall be provided.

J. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.

K. Coolant heater

1. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.

2. The coolant heater shall be installed on the engine with high temperature silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

3. The coolant heater shall be provided with a 12VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

4. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100F (40C) in a 40F ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

L. Provide vibration isolators, spring/pad type or as recommended by the manufacturer, quantity as recommended by the generator set manufacturer.

M. Starting and Control Batteries shall be calcium/lead antimony type, 12 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors.

2.03 AC GENERATOR

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Oversized Alternator rating of 60KW/60KVA with actual temperature rise measured by resistance method at full load for specified alternator end shall not exceed 125 degrees Centigrade. Specified alternator is oversized.

B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

D. The subtransient reactance of the alternator shall not exceed 15 percent, based on the standby rating of the generator set.

E. The alternator shall be capable of operation with reverse kVAR of 0.15 per unit.

2.04 GENERATOR SET CONTROL

The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set.

The control shall be mounted on the generator set and shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

The generator set mounted control shall include the following features and functions:

A. Control Switches

1. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
2. EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
3. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
4. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

B. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

1. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor.

Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.

2. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.

3. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.

4. The control system shall log total number of operating hours, total kWH, and total control on hours, as well as total values since reset.

C. Generator Set Alarm and Status Display.

1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
    a. The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown function monitored by the genset. They shall also be configurable for color, and control action (status, warning, or shutdown).
    b. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
    c. The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.
    d. The control shall include an amber common warning indication lamp.

2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:
    a. low oil pressure (warning)
    b. low oil pressure (shutdown)
    c. oil pressure sender failure (warning)
    d. low coolant temperature (warning)
    e. high coolant temperature (warning)
    f. high coolant temperature (shutdown)
    g. high oil temperature (warning)
    h. engine temperature sender failure (warning)
    i. low coolant level (warning)

j. fail to crank (shutdown)
k. fail to start/overcrank (shutdown)
l. overspeed (shutdown)
m. low DC voltage (warning)
n. high DC voltage (warning)
o. weak battery (warning)
p. high AC voltage (shutdown)
q. low AC voltage (shutdown)
r. under frequency (shutdown)
s. over current (warning)
t. over current (shutdown)
u. short circuit (shutdown)
v. over load (warning)
w. emergency stop (shutdown)
x. (3) configurable conditions

3. Provisions shall be made for indication of three customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

D. Engine Status Monitoring.

1. The following information shall be available from a digital status panel on the generator set control :
   a. engine oil pressure (psi or kPA)
   b. engine coolant temperature (degrees F or C)
   c. engine oil temperature (degrees F or C)
   d. engine speed (rpm)
   e. number of hours of operation (hours)
   f. number of start attempts
   g. battery voltage (DC volts)

2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

E. Engine Control Functions.

1. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
2. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
3. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification.

4. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
5. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

F. Alternator Control Functions:

1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
2. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445. The protection for this function shall be 3rd party certified to very performance.
3. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445. The protection for this function shall be 3rd party certified to very performance.
4. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
5. A line to neutral sensing AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

G. Other Control Functions

1. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than or more than regulated VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.
2. Control Interfaces for Remote Monitoring:
3. The control system shall provide three programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control. The relays shall be configured to indicate: (1) generator set operating at rated voltage and frequency, (2) common warning, (3) common shutdown.
4. A fused 10 amp switched 12VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
5. A fused 10 amp 12VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.

2.05 OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET

A. The generator set shall be provided with a mounted main line circuit breaker, sized @ 225 Amps to carry the rated output current of the generator set. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

B. Outdoor Sound-Attenuated Enclosure

The generator set shall be provided with a factory sound-attenuated outdoor enclosure. The sound-attenuated housing shall allows the generator set to operate at full rated load in an ambient temperature of up to 100F. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 71.1 dBA at any location 7 meters (23') from the generator set in a free field environment, with the average dBA @ 23' being 69.1dBA. The enclosure shall be insulated with non-hydroscopic materials. The exhaust silencer shall be fully enclosed within the gen set enclosure, not external on roof or in radiator duct exposed to the elements.

C. Battery charger, 15 Amp Auto-Float equalize type with alarms (See ATS specs for complete battery charger specification – Charger may be either mounted in ATS or alternatively provided pre-mounted on vibration isolator mounting and pre-wired in the generator set enclosure. If mounted at gen set all mounting & wiring by factory or provided by the gen set equipment distributor prior to shipment of equipment to jobsite.

PART 3 OPERATION

3.01 SEQUENCE OF OPERATION

A. Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control.

B. The generator set shall complete a time delay start period as programmed into the control.

C. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:

1. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate “fail to crank” shutdown.

2. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate “fail to start”.

3. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

D. On reaching rated speed and voltage, the generator set shall operate in isochronous govern state.

E. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

F. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.

1. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

PART 4 OTHER REQUIREMENTS

4.01 SUBMITTALS

A. Manufacturer’s product literature and performance data, sufficient to verify compliance to specification requirements.

B. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.

C. Manufacturer's certification of prototype testing.

D. Manufacturer's published warranty documents.

E. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.

F. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.

G. Manufacturer's installation instructions.

4.02 FACTORY TESTING

A. The generator set supplier shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

B. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable.

4.03 INSTALLATION

A. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer’s instructions and seismic requirements of the site.

D. Equipment shall be initially started and operated by representatives of the manufacturer.

E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

4.04 ON-SITE ACCEPTANCE TEST

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by manufacturer’s authorized equipment distributor technicians. The Engineer shall be notified in advance and shall have the option to witness the tests.

B. Installation acceptance tests conducted on-site shall include a "cold start" test and site connected load test.

C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 1 hour. Coordinate timing and obtain approval for start of test with site personnel.

4.05 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 1 hour in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner. The equipment distributor shall allow for a separate trip for training site personnel (not at start up). Training to be performed by the equipment distributor's service technician.

4.06 SERVICE AND SUPPORT

A. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The generator set shall be serviced by a local distributor service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year. This is not assignable to dealers or third party maintenance organizations.

C. The manufacturer shall maintain model and serial number records for at least 20 years.

D. Distributor must have 24-hour emergency service, in house rental fleet of a size to back up this site, factory trained power systems field service technicians, total parts, service and warranty support for all portions of equipment supplied.

4.07 WARRANTY

A. The generator set, auto transfer switch and associated equipment shall be covered by a two year comprehensive extended warranty from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, mileage, service hours, repair parts cost, etc.. Comprehensive Generator Warranty shall also apply to the ATS. ATS must be warranted by the same equipment distributor service organization. ATS warranty shall also be 2-Year comprehensive with no deductibles.

END OF SECTION 26 32 13
ELECTRICAL GENERAL SYSTEMS

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SECTION 26 36 23

EMERGENCY / STANDBY POWER SYSTEMS TRANSFER SWITCH

PART 1 GENERAL

1.01 SCOPE

A. Provide complete factory assembled power transfer equipment with electronic microprocessor-based controls designed for fully automatic operation and including: surge, voltage isolation, voltage sensors on all phases of the normal source and one phase of the emergency source, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.

B. The generator set manufacturer shall produce and warranty the transfer switch to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product and employed by the generator set supplier shall service the transfer switches. Technicians shall have passed qualification examinations on the product, and be certified by the manufacturer as capable of effectively servicing the equipment provided.

1.02 CODES AND STANDARDS

A. The automatic transfer switch shall conform to the requirements of the following codes and standards:

1. UL1008. The transfer switch shall be UL listed and labeled.

2. IEEE Standard C62.41 and C62.45.

3. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

4. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

5. NEMA ICS10-1993 – AC Automatic Transfer Switches.

B. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.03 ACCEPTABLE MANUFACTURERS

A. Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on transfer switches manufactured by Cummins Power Generation. Auto Transfer Switch Equipment built by Caterpillar or Kohler that meets the requirements of this specification are acceptable, if approved not less than two (2) weeks before scheduled bid date. Aftermarket or brand-labeled ATS do not meet this specification. Proposals must include a line by line compliance statement based on this specification.

PART 2 PRODUCTS

2.01 POWER TRANSFER SWITCH

A. Ratings

1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories. ATS shall be 225 Amp industrial grade contactor based.

2. Main contacts shall be rated for 600 VAC and the operation voltage as installed.

3. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of -30 to +60 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000M).

4. Transfer switch equipment shall have withstand and closing ratings (WCR) I RMS symmetrical amperes greater than the available fault currents shown on the drawings. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application. Minimum WCR for the ATS shall be 65,000 with specific MCCB or 200,000 with current limiting fuses. ATS contactor shall be rated for 600VAC operation.

B. Construction

1. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions.

2. Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.

3. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with line voltage components.

4. Transfer switches shall be 3-pole. 3-Pole equipment shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.

5. Enclosures shall be UL Listed and NEMA 1 rated enclosure. The enclosure shall provide NEC wire bend space when both sources and the load are all connected from either the top or bottom of the transfer switch. The cabinet door shall be key-locking.

C. Connections

1. Field control connections shall be made on terminal blocks that are clearly and permanently labeled.

2. Transfer switch shall be provided with Al/CU mechanical lugs sized to accept the full output rating of the transfer switch.

2.02 TRANSFER SWITCH CONTROL

A. Solid-state under voltage sensors shall simultaneously monitor both sources. Pick-up and drop-put settings shall be adjustable.

B. Automatic controls shall signal the engine-generator set to start upon signal from normal source sensor. Solid-state time delay start, adjustable from 0 to 10 seconds (factory set at 2 seconds) shall avoid nuisance start-ups. Battery voltage starting contacts shall be silver alloy, dry type contacts, factory wired to a field wiring terminal block.

C. The switch shall transfer when the emergency source reaches the set point. Provide a solid-state time delay on transfer, adjustable from 2 to 120 seconds, factory set at 3 seconds.

D. The switch shall retransfer the load to the normal source after a time delay retransfer, adjustable from 6 seconds to 30 minutes, factory set at 5 minutes. Retransfer time delay shall be immediately bypassed if the emergency power source fails.

E. Controls shall signal the engine-generator set to stop after a time delay, adjustable from 0 to 10 minutes, and factory set at 5 minutes, beginning on return to the normal source.

F. The control system shall include field adjustable provisions to control the speed of operation of the transfer switch power contacts. In addition, the control shall include a field-configurable in-phase monitor function that causes the transfer to be initiated only when the sources are in phase. When in-phase transfer is enabled and transfer does not occur with 120 seconds, the control shall automatically transfer the load using delayed transfer.

G. Provide an exerciser clock with provisions for operating the generator set for a test period in either with-load or without-load configuration. Plant exerciser shall be repeating type.

H. Power for transfer switch operation shall be derived from the source to which the load is being transferred.

I. Provide a minimum 15 amp battery charger for the generator set battery bank. The charger shall be mounted in the Auto Transfer Switch or provided pre-mounted on vibration isolating mounting and pre-wired in the generator set enclosure. Charger shall include the following capabilities:

1. Charges shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.

2. The charger shall be compliant with UL991 requirements for vibration resistance.

3. The charger shall comply with the requirements of EN61000-4-5 for voltage surge resistance; EN50082-2 for immunity; EN61000-4-2 for ESD; EN61000-4-3 for radiated immunity; ANSI/IEEE C62.41 category B and IN61000-4-4 for electrically fast transient; EN61000-4-6 for conducted emissions; and FCC Part 15 Class A for radiated emissions.

4. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL-labeled with the maximum battery amp-hour rating that can be recharged within 24 hours. The label shall indicate that the charger is suitable for charging of 200AH batteries per NFPA requirements.

5. The charger shall incorporate a 4-state charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100 percent of charge, and a float stage to maintain a fully charge battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.

6. The DC output voltage regulation shall be within plus or minus 1%. The DC output ripple current shall not exceed 1 amp at rated output current level.

7. The charger shall include the following features:

    a. Two line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming;

    b. LED indicating lamp(s) to indicating normal charging condition (green), equalize charge state (amber), and fault condition (red);

    c. AC input overcurrent, over voltage, and undervoltage protection;

    d. DC output overcurrent protection;

    e. Alarm output relay;

    f. Corrosion resistant aluminum enclosure.

J. Supply power failed indication shall be displayed on the ATS control panel.

2.03 FRONT PANEL DEVICES

Provide control switches mounted on cabinet front for:

A. Test – Simulates normal power loss to control for testing of generator set. Controls shall provide for a test with our without load transfer.

B. Override – Momentary position to override retransfer time delay and cause immediate return to normal source, if available.

C. Provide LED-type switch position and source available indicator lamps on the front of the transfer switch cabinet.

2.04 CONTROL INTERFACE

A. The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set.

B. Provide auxiliary dry contacts to indicate the following conditions: load connected to source 1, source 2 connected to load.

2.05 ENCLOSURE

A. The cabinet door shall be key-locking.

B. Transfer switch equipment shall be provided in a NEMA 1 or better enclosure.

C. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles shall be accessible to authorized personnel only by opening the key-locking cabinet door.

PART 3 OPERATION

3.01 OPEN TRANSITION SEQUENCE OF OPERATION

A. Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to the loads when normal source fails. The normal position of the transfer switch is source 1 (connected to the utility), and no start signal is supplied to the genset.

B. Generator Set Exercise (Test) With Load Mode. The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:

1. Transfer switch control shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator (test).

2. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.

3. The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the generator set to the normal service.

4. On completion of the exercise period, the transfer switch control shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.

5. The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

C. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:

1. Transfer switch control shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.

2. The control system shall operate the generator set unloaded for the duration of the exercise period.

3. At the completion of the exercise period, the transfer switch control shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

PART 4 OTHER REQUIREMENTS

4.01 FACTORY TESTING. The transfer switch supplier shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be available on request. Test process shall include calibration of voltage sensors.

4.02 SERVICE AND SUPPORT

A. The manufacturer of the transfer switch shall be the same as the generator set. They shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The transfer switch shall be serviced by a local distributor service organization that is trained and factory certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of the transfer switch for at least twenty (20) years.

D. The ATS shall be provided with a Two Year Comprehensive Warranty covering parts, labor, travel time, and mileage with no deductible.

END OF SECTION 26 36 23
EMERGENCY / STANDBY POWER SYSTEMS TRANSFER SWITCH

SECTION 27 51 00

INTERCOM SYSTEM

1.01 GENERAL REQUIREMENTS & SCOPE

A. Furnish and install a complete new apartment intercom system.

B. All bids shall be based on the equipment as specified herein. The catalog numbers and model designations are that of Aiphone. The specifying authority must approve any alternate system.

C. Bidders wishing to submit alternate equipment shall submit to the specifying authority, at least ten (10) days prior to bid opening, the equipment proposed to provide a precise functional equivalent system to meet specifications. Bidder shall provide adequate information prior to bid date such as specification sheets, working drawings, shop drawings, and a demonstration of the system. Alternate supplier-contractor must also provide a list to include six (6) installations of the identical system proposed which have been in operation for a period of two (2) years.

D. Final approval of the alternate system shall be determined at the time of job completion. Failure to provide the “precise functional equivalent” shall result in the removal of the alternate system at the contractor’s expense.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of Contract apply to this Section.

B. Requirements of the following apply to this Section:

1. Basic Electrical Requirements
2. Basic Electrical Materials and Methods

1.03 SUMMARY

A. This Section addresses the needs and requirements of the addressable intercom system. It includes requirements for the intercom system components including, but not limited to, the following:

1. Building Entry Panel
2. System Power Supply
3. Apartment Intercom Station

1.04 SYSTEM DESCRIPTION

General: Furnish and install all equipment, accessories, and materials in accordance with these specifications and drawings to provide a complete and operating apartment intercom system.

1.05 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract Sections:

1. Submit equipment prints, full electronic wiring diagrams and specifications sheets for each item specified herein. Provide a tabulation of the specification clearly comparing the submitted item with the specified item, being able to refer to all written expressed functions and capabilities. Specification sheets shall be submitted on all items.

2. Wiring diagrams, detailing wiring for power, signal, and control.

3. Submit wiring diagrams showing typical connections for all equipment.

4. Submit a certificate of completion of installation and service training.

1.06 QUALITY ASSURANCE

A. All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.

B. The contractor shall be an established communications and electronics contractor that has had and currently maintains a locally run and operated business for at least three (3) years. The contractor shall utilize a duly authorized distributor of the equipment supplied for this project location with full manufacturer's warranty privileges.

C. The contractor shall show satisfactory evidence, upon request, that the supplier maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The supplier shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

D. Electrical Component Standard: Provide work complying with applicable requirements of NFPA 70, 2005 "National Electrical Code" including, but not limited to:

1. Article 250, Grounding.
2. Article 300, Part A. Wiring Method.
3. Article 310, Conductors for General Wiring.
4. Article 725, Remote Control, Signaling Circuits.
5. Article 800, Communication Systems.

E. Installation and start up of all systems shall be under the direct supervision of a local agency regularly engaged in installation, repair, and maintenance of such systems. The supplier shall be accredited by the proposed equipment manufacturers.

F. The agency providing equipment shall be responsible for providing all specified equipment and mentioned services for all equipment as specified herein. The agency must be a local authorized distributor of all specified equipment for single source of responsibility and shall provide documents proving such. The agency must provide written proof that the agency is adequately staffed with factory-trained technicians for all of the specified equipment. The agency must have established business for and currently be providing all services for the equipment.

G. The contractor shall guarantee availability of local service by factory-trained

personnel of all specified equipment from an authorized distributor of all equipment specified under this section. Maintenance shall be provided at no cost to the purchaser for a period of one (1) year (parts and labor) from date of acceptance unless damage or failure is caused by misuse, abuse, neglect, or accident

H. The contractor shall, at the owner's request, make available a service contract offering continuing factory authorized service of the system after the initial warranty period.

I. The supplier shall visit the sites and familiarize himself with the existing conditions and field requirements prior to submitting a proposal.

J. The contractor is responsible for all cost associated with proper installation, termination, configuration, programming, impedance and load matching of all system components.

K. The contractor shall provide all necessary masonry, covering, patching, and painting work in order to render any residue of the existing central equipment invisible. All finished surfaces shall be chosen in consultation with the Owner, to assure that the Owner's aesthetic preferences have been adhered to.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in factory boxes. Store in clean, dry space in original boxes. Protect products from fumes and construction traffic. Handle carefully to avoid damage.

1.08 IN-SERVICE TRAINING

A. The contractor shall provide training with this system. These sessions shall be broken into segments that will facilitate the training of individuals in the operation of this system. Operators Manuals and Users Guides shall be provided at the time of this training.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The manufacturer shall be:

Aiphone Corporation.
Distributed by Video-Tech-Tronics, Inc...
859 West River Center Dr., Comstock Park, MI 49421
Contact: Jeff VanSkiver, Phone: 616 785-3700, FAX 616 785-9352
jvanskiver@videotechtronics.com

B. The new tenant intercom shall be the Aiphone GT series intercom.

C. The intent of this specification is to establish a standard of quality, function and features. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard set forth in these specifications.

D. The functions and features specified are vital to the operation of this facility; therefore, the acceptance of alternate manufacturers does not release the

contractor from strict compliance with the requirements of this specification.

E. The Contractor for this work shall be held to have read all of the Bidding Requirements, the General Requirements, and Contract Proposal Forms; and in the execution of this work, he will be bound by all of the conditions and requirements therein.

F. The contractor shall be responsible for providing a complete functional system including all necessary components whether included in this specification or not.

G. In preparing the bid, the bidder should consider the following:

1. No claim will be made against the owner for any costs incurred by the bidder for any equipment demonstrations which the owner requests.

H. Any prior approval of an alternate system does not automatically exempt the supplier from the intent of these specifications. Failure to comply with the operational and functional intent of these specifications may result in the total removal of the alternate system at the expense of the contractor.

I. Alternate equipment shall be considered if submitted to the specifying authority at least ten (10) days prior to bid date. Submission of an alternate shall contain an original draft point by point comparison of the submitted product relative to the requirements of this specification, engineering drawings of the system, and specification sheets covering all components of the system as well as all items of Section 1 “SUBMITTALS”. The system and equipment drawings and specification sheet shall meet all items of the specification.

J. Proposed alternate equipment shall be accompanied by a letter from the manufacturer clearly stating that they have read the specifications, have listed differences between their product and the specified product, and commit to meet or exceed the specified requirements herein.

K. All proposed alternate systems must comply with Section 2.1, letters H and I above. Submissions failing to comply with the aforementioned requirement shall be deemed as non-compliant.

2.02 SYSTEM REQUIREMENTS

A. The intercom system shall utilize a circulating single pair of wires to support the tenant stations. Systems requiring home runs from the tenant stations to the building entry panel are not desired and will not be accepted. The building entry panel is equipped with a video camera that transmits the image of the caller to the called apartment. A scrolling LCD directory that identifies the occupant and their unit number. Entering that number on the entry panel keypad will place a call to the tenant intercom station. The tenant can view the caller’s image on the apartment intercom viewing screen and answer the call in a hands free mode or a push to talk mode. The tenant station is equipped with a door release button to allow the tenant to unlock the entrance door. Each tenant unit will be provided a door bell button that will activate a distinct tone at the tenant station to indicate a door call.

2.03 SYSTEM

Equipment lists are supplied for illustrative purposes; contractor shall supply all types

and quantities of equipments necessary to comply with the intent of the specification.

A. Building Entrance Panel
Aiphone GT, All-in-One Audio Visual

B. Apartment Intercom Stations

1. Aiphone GT-1C Tenant Audio Video Stations

C. Electric strike and necessary power supply for the entrance door shall be furnished by the hardware supplier. Intercom vendor shall coordinate strike voltage with the hardware supplier. Electrical contractor shall install and provide power to the entrance door power supply.

D. The intercom vendor shall coordinate any interface necessary with the handicapped opener, if provided. The analog and the digital clock shall include automatic digital calibration for time base to minimize deviation from each other.

E. Doorbell buttons for the tenant units shall be selected by the architect and supplied by the general trades. Intercom vendor shall ensure that the selected doorbell buttons are compatible with the intercom tenant station. The intercom vendor is responsible for installation and wiring of the doorbell buttons.

F. Intercom model numbers used in this specification are for illustrative purposes; the vendor shall supply a complete working system including all components recommended by the manufacturer.

PART- 3 EXECUTION

3.01 GENERAL

A. Install system in accordance with applicable codes. Install equipment in accordance with manufacturer's written instructions.

B. Conceal wiring except in unfinished spaces.

C. All new wiring on this project must be properly rated for the application

D Cable to the new devices at new locations shall be installed in a neat and workmanlike manner, following the standard procedures used in the electrical contracting trade.

E. Exposed wiring will not be permitted under any circumstances on this project.

F. Upon installation completion, a unit by unit test shall be conducted for every device in the system. A technician shall perform the test, and repairs shall be performed as needed at no cost to the Owner to any devices, which do not function correctly, including cable. A written room-by-room report following testing and repairs shall be prepared and submitted to the Engineer

3.02 FIELD QUALITY CONTROL

A. Contractor Field Service:

1. Provide services of a service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

B. Inspection

1. Make observations to verify that units and controls are properly labeled.

C. Testing:

1. Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at the Contractor's expense. Verify by the system test that the total system meets the specifications and complies with applicable standards.

3.03 COMMISSIONING

A. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. Operators Manuals and Users Guides shall be provided at the time of this training.

B. Schedule training with Owner through the Architect, with at least seven (7) days advance notice.

3.04 CLEANING AND PROTECTION

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

END OF SECTION 27 51 00
INTERCOM SYSTEM

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SECTION 28 13 00

CARD ACCESS CONTROL

PART 1 – GENERAL

1.01 SPECIFICATION INTENT

Dwelling Place has a “campus-wide” access control system serving their various facilities. The system is administered from their corporate offices with the owner’s LAN being used as the communications means. The access control equipment at this site will be connected to the owner’s LAN and become part of their campus system. This specification provides the minimum requirements for the building card access system. The system shall include, all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system meeting the requirements of this specification.

ALTERNATES

Only the manufacturer’s equipment that is explicitly mentioned in this specification are supplied. Substitutes are not allowed.

Equivalence: No item shall be substituted without the prior written and approved documentation that assures that the substituted part/parts are exactly the same, technically and aesthetically speaking. The substituted parts must provide the same or significantly improved performance.

1.02. MANUFACTURER, CONTRACTOR

A. Equipment by Continental Instruments constitutes the minimum type and quality of equipment to be installed. The system shall be furnished and installed by a company appointed by the manufacturer as a Certified Access Control Integrator. The pre-approved supplier and contractor for this project is Video-Tech-Tronics, Inc. (616) 785-3700.

B. All technicians and engineers involved in the project must be trained and certified on the ACS software and associated interfaces by the manufacturer prior to the bid.

1.03. DOCUMENTATION

A complete set of shop drawings shall be supplied. The shop drawings shall be reproduced electronically in digital format. All drawings and diagrams shall include the Contractor's title block, complete with drawing title, contractor's name, address, date including revisions, and preparer's and reviewers initials.

1.04 SUBMITTALS

A. Submit under provisions of Section 28 00 00

B. Product Data:
   1. Manufacturer’s data, operator and installation manuals software programs.

C. Shop Drawings; include
   1. System device locations on architectural floor plans.
   2. Full Schematic of system, including wiring information for all devices.

D. Closeout Submittals
   1. User manual.
   2. Parts list.
   3. Connection diagram.
   4. Installation CD.
   5. Software license.

1.05 QUALITY ASSURANCE

A. Manufacturer:
   1. Minimum of ten (10) years experience in manufacture and design of electronic security systems including sophisticated PC-based systems and digital products.

B. Manufacturer's quality system: Registered to ISO 9001:2000 Quality Standards.

C. Installer:
   1. Minimum of five (5) years experience installing CCTV systems.

1.06 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 60 00.

B. Deliver materials in manufacturer's original, unopened, undamaged packaging; and unharmed original identification labels.

C. Protect store materials from environmental and temperature conditions following manufacturer's instructions.

D. Handle and operate products and systems according to manufacturer's instructions for installation, environmental, mechanical or electrical requirements and within thermal stress limits.

E. Ensure conformance with operating limitations according to applicable data sheet.

1.07 WARRANTY

A. Provide manufacturer's warranty covering three (3) years for CCTV products to repair and replace defective equipment.

B. Exchanges available for product failures.

PART 2 – PRODUCTS

2.01 CARD READER(S)

Where shown on the drawings provide an HID proximity card reader. Card reader shall be waterproof and suitable for exterior mounting. Provide switch plate or mullion mount as directed by the engineer.

2.02 DOOR STRIKE(S)

Door strikes shall be furnished by the hardware vendor. Access control contractor shall coordinate installation and voltage requirements with the hardware vendor.

2.03 DOOR MONITOR SWITCH(S)

Provide and install a door monitor switch at each door equipped with a card reader. Utilize a Sentrol model 1078 flush, wide gap door monitor switch. Monitor switch shall provide indication of forced door, door propped open and activate relocking to prevent tailgating.

2.04 REQUEST TO EXIT DEVICE(S)

Provide a request to exit device at each door equipped with a card reader. Provide General Electric model RCR-REX passive infrared device in either white or black as directed by the engineer.

2.05 DOOR CONTROLLER PANELS

Provide modular door controller modules in the quantity necessary to support the doors equipped with access control card readers. Door controller modules shall be equipped with onboard Ethernet (LAN) capability as well as RS-485 to enable communication with the access control computer or other door controller panels via RS-485 or LAN communications. Provide door controller panels with battery backup to ensure that the access control system will function in the event of a power failure. Battery backup will be provided for the strike as well as the controller electronics.
Controller Hardware shall be of a distributed architecture nature so that in the event of a server failure the local controller will make all decision utilizing both the Facility code and the unique ID and be capable of:

1. 2 to 16 card readers per panel
2. 1,000,000 card holders per panel
3. Card formats ranging from 26 bit to 256 bits
4. Processing data at 52 MIBS, (million instructions per second)
5. Down load speeds to the controller not to exceed 6 minutes for 100,000 card records utilizing the 200 bit format
6. IPV IV and IPV VI Ethernet communications
7. Support AES 128/256 encryption
8. Time zone offsets
9. Reporting alarms to a central monitoring station via Ethernet without the assistance of an integrated alarm panel
10. Changing addresses of inputs and outputs for door control
11. Global I/O functions
12. Communications of Ethernet TCP/IP, RS 232, RS 422 or a combination thereof

2.06 INTERCOM SYSTEM INTERFACE

Interface the access control system with the door entry intercom to provide door release from the intercom stations in the resident apartments. Operation of the door release switch on the intercom stations shall unlock the entry door for a programmed period of time.

2.07 INSTALLATION

A. Circuit Wiring

Wire system in accordance with manufacturer's recommendations.

B. Conductors

Utilize circuit conductors as directed by the manufacturer but not less than 22 AWG for reader and monitor circuits and 18 AWG for door strikes

2.08 WARRANTY AND TRAINING

A. Warranty

The contractor shall warranty all materials, installation and workmanship for one (1) year from date of first beneficial use, unless otherwise specified. A copy of the manufacturer's warranty shall be provided with close-out documentation and included with the operation and installation manuals.
The System Supplier shall maintain a service organization with adequate spare parts stock within 75 miles of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the owner notifying the contractor.

B. Training

The System Supplier shall schedule and present a minimum of 4 hours of documented formalized instruction for the building owner, detailing the proper operation of the installed System. Contractor shall provide 25 proximity fobs for owner's use in programming the system. Provide these to the owner prior to formalized training.

PART 3 – EXECUSION

3.01 EXAMINATION

A. Examine areas to receive devices and notify adverse conditions affecting installation or subsequent operation.

B. Do not begin installation until unacceptable conditions are corrected.

C. Ensure environmental, mechanical and electrical requirements are met.

3.02 PREPARATION

A. Protect devices from damage during construction.

3.03 INSTALLATION

A. Install devices in accordance with manufacturer's instruction at locations indicated on the drawings.

B. Perform installation with qualified service personnel.

C. Install devices in accordance with the National Electrical Code or applicable local codes.

D. Ensure selected location is secure and offers protection from accidental damage.

E. Location must provide reasonable temperature and humidity conditions, free from sources of electrical and electromagnetic interference.

3.04 FIELD QUALITY CONTROL

A. Test proper operation of all video system devices.
   1. Communication between recorder and cameras.
   2. Independent operation of alarms, and cameras.

B. Test proper operation of software programs.

C. Determine and report all problems to the manufacturer's customer service department.

D. Determine and report all problems to the manufacturer´s customer service department.

3.07 GENERAL SYSTEM NOTES

A. Automatic Door Entry/Intercom and Card Access Details

1. Automatic door openers are supplied and installed by the door entry contractor. Automatic door opener contractor shall supply installation manuals to the intercom vendor for their use in preparing drawings.
2. Electric locks for the entry doors are provided by the hardware supplier.
3. AC power for the openers is provided and installed by the electrical contractor.
4. AC power for other components of the entry system (entry intercom panel, power supplies, etc.) is provided by the electrical contractor.
5. Conduit, boxes and sleeves necessary for the entry system are supplied and installed by the electrical contractor.
6. Control wiring for the automatic door opener, operator switches (paddles), card readers, telephone entry panel, electric locks and interface equipment is the responsibility of the contractor supplying the telephone access entry system.
7. The apartment intercom system supplier shall contact the door opener contractor to obtain necessary installation manuals and blueprints for the provided system(s).
8. Coordination of this installation is the responsibility of the general contractor.

B. Details of operation of this system are as follows:

1. Where there is a vestibule the outer doors are not interfaced with the access system and operate at all times unless manually shut off at the door’s controller.

2. Operation of the apartment intercom system or the card reader will unlock the electric lock and enable the automatic door opener operator switch (paddle) within the vestibule. At locations without a vestibule this operation will enable the exterior operator switch. The opener will not operate in response to entry access or card reads.

3. Interior operator switches (paddles) will unlock the door and operate the opener.

C. Provide a CAD drawing detailing interface details for review by the project engineer. Accompany this drawing with a narrative of operation. Provide this submittal within 45 days of approval of system submittals.

END OF SECTION 28 13 00
CARD ACCESS CONTROL

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SECTION 28 23 00

CLOSED CIRCUIT TELEVISION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Digital Video Recorders and Video Camera Devices.

1.02 REFERENCES

A. EMC USA
1. FCC Part 15, Class B

B. International Organization for Standardization (ISO) (www.iso.ch)
1. ISO 9001 – Quality management Systems

C. Underwriters Laboratories, Inc. (UL)
1. UL60950 – 2001 Information technology equipment

D. Environmental
1. RoHS compliant

E. 4CIF resolution is four (4) times higher than that of CIF images, or 704 pixels wide and 576/480 (PAL/NTSC) pixels tall (704 x 576/480).

1.03 CODES AND STANDARDS

A. Work shall be performed in accordance with the applicable international, federal, state, and local codes or standards current at the commencement of installation. The following list summarizes applicable standards:

1. UL 294, ULC
2. CE
3. FCC – Part 15, Part 68
4. NFPA70, NEC
5. IEEE, RS170 variable standard
6. IEEE, NTSC (color camera broadcast)

B. Where more than one code or regulation is applicable, the more stringent shall apply.

C. Cable installation, identification and termination shall be performed in accordance with the Manufacturer's technical installation guidance, in addition to the applicable codes above.

D. In the absence of the Manufacturer's recommendations on conductor application, the Contractor shall ensure that the cable selected meets all technical requirements of the equipment to be installed.

1.04 SYSTEM DESCRIPTION AND INTENT OF SPECIFICATION

A. The intent of this specification is to provide a complete closed circuit television video surveillance system with digital recording. The following requirements are reflective of the intent of this specification and if any other items of the specification appear to be in conflict with these requirements, this section of the specification will apply.

B. The system digital video recorder must reside on the Owner's existing DIGIOP digital video network.

C. The system consists of interior and exterior cameras, digital recording devices, power supplies and video monitors. There are no pan, tilt and zoom cameras employed. All cameras are equipped with vari-focal lenses; fixed focal length lenses are not desired or allowed.

D. Building cameras, both interior and exterior, will be wired with West Penn 815 for video and West Penn 224 for power. Equivalent cables may be used provided they are approved at the time of submittal. Note the CATV type coaxial cables will not be approved.

E. Provide a sleeve from accessible ceiling space to exterior camera locations. Seal this sleeve IAW NFPA 70.

F. Ceiling mount interior cameras. Provide a separate, fused power supply to each camera (interior and exterior). Electrical contractor to provide 120 volt power to camera power supply.

G. Mount flat screen monitor at DVR location for use in image review.

1.05 SUBMITTALS

A. Submit under provisions of Section 28 00 00.

B. Product Data:
1. Manufacturer's data, operator and installation manuals software programs.

C. Shop Drawings. Include:

1. System device locations on architectural floor plans.
2. Full Schematic of system, including wiring information for all devices.

D. Closeout Submittals:

1. User manual.
2. Parts list.
3. Connection diagram.
4. Installation CD.
5. Software license.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1. Minimum of ten (10) years experience in manufacture and design of electronic security systems, including sophisticated PC-based systems and digital products.

B. Manufacturer's quality system: Registered to ISO 9001:2000 Quality Standards.

C. Installer:
1. Minimum of five (5) years experience installing CCTV systems.

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 60 00.

B. Deliver materials in manufacturer's original, unopened, undamaged packaging; and unharmed original identification labels.

C. Protect store materials from environmental and temperature conditions following manufacturer's instructions.

D. Handle and operate products and systems according to manufacturer's instructions for installation, environmental, mechanical or electrical requirements and within thermal stress limits.

E. Ensure conformance with operating limitations according to applicable data sheet.

1.08 WARRANTY

A. Provide manufacturer's warranty covering three (3) years for CCTV products to repair and replace defective equipment.

B. Exchanges available for product failures.

1.09 MAINTENANCE

A. Make ordering of new equipment for expansions, replacements, and spare parts available to end users.

B. Provide factory direct technical support from 8:00 a.m. to 8:00 p.m. via phone or e-mail, or any time via Web.
1. Provide toll-free numbers to contact customer support.

C. Provide on-site training and on-line training via web.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Bosch Security Systems, Inc.
2. DIGIOP Technologies, LTD

B. Substitutions: Not Permitted.

C. Acceptable Contractor: Video-Tech-Tronics, Inc. Contact person is Jeff VanSkiver at (616) 785-3700, jvanskiver@videotechtronics.com.

2.02 DIGIOP NETWORK DIGITAL VIDEO RECORDER

A. General Description:

1. Flexible and scalable CCTV management system in an easy-to-use versatile design.
2. View, record, control cameras, handle alarms and check device status through one interface.
3. Real-time digital recording at 25/30 IPS in CIF resolution on all channels simultaneously, with the ability to record at resolutions up to 4CIF.
4. Real-time live display at 25/30 IPS in 4CIF resolution for greater detail as needed.
5. Multiple control options.
6. Remote configuration and management of devices on surveillance system.
7. Powerful search and playback functions, including Smart Search.
8. Available in 8 and 16 channel versions with a variety of hard drive capacities.
9. Internal storage capacity up to 3 TB.
10. Optional internal DVD available.
11. Synchronous audio/video.
12. Video player with image authentication (watermarking).
13. NTSC and PAL selectable video format.

B. Provide DIGIOP NVRR1000C

2.03 BOSCH FLEXIDOME DN CAMERA SERIES VDN-498V (EXTERIOR CAMERAS)

A. The product specified shall be:

1. A day/night, vandal and tamper resistant, 540 TVL resolution color fixed dome camera designed for indoor/outdoor applications using a 1/3-inch format CCD imager.
2. The camera switches automatically from color monochrome to provide enhanced night viewing.
3. The unit is prepackaged in cast aluminum housing with a thermostatically-controller heater, a polycarbonate dome bubble, and a hardened inner liner capable of withstanding the equivalent of 120 lbs. (55 kg) of force.
4. The dome bubble is clear polycarbonate material with a UV blocking anti-scratch coating.

B. Provide Bosch VDN-498V09 cameras. Use VDA-445 wall mount brackets. Provide with a UPA-2410-60 power supply.

2.04 BOSCH FLEXIDOME COLOR INTERIOR CAMERAS VDC480 (INTERIOR)

A. The product specified shall be:

1. A high resolution fixed color camera designed for indoor applications using a 1/3-inch format CCD imager.
2. The unit is pre-packaged with a polycarbonate dome bubble and hardened inner liner.
3. The camera is equipped with a vari-focal 3-9mm lens.

B. Provide Bosch VDC-480VO3-20 cameras. Provide a Bosch LTC 5416/60 multi-camera power supply for the interior cameras.

2.05 BOSCH FLAT SCREEN COLOR MONITOR

A. The unit specified shall be:

1. A high resolution color monitor designed for CCTC applications.
2. The monitor is equipped with a mounting stand suitable for desk or table mounting.
3. Wall mounting is available with optional wall mount bracket.

B. Provide Bosch UML-191-90 High resolution color monitor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive devices and notify adverse conditions affecting installation or subsequent operation.

B. Do not begin installation until unacceptable conditions are corrected.

C. Ensure environmental, mechanical, and electrical requirements are met.

3.02 PREPARATION

A. Protect devices from damage during construction.

3.03 INSTALLATION

A. Install devices in accordance with manufacturer's instructions at locations indicated on the drawings.

B. Perform installation with qualified service personnel.

C. Install devices in accordance with the National Electrical Code or applicable local codes.

D. Ensure selected location is secure and offers protection from accidental damage.

E. Location must provide reasonable temperature and humidity conditions, free from sources of electrical and electromagnetic interference.

3.04 FIELD QUALITY CONTROL

A. Test proper operation of all video system devices.

1. Communication between recorder and cameras.
2. Independent operation of alarms and cameras.

B. Test proper operation of software programs.

C. Determine and report all problems to the manufacturer's customer service department.

3.05 ADJUSTING

A. Make proper adjustment to video system devices for correct operation in accordance with manufacturer's instructions.

B. Make any adjustment of camera settings to comply with specific customer's need.

3.06 DEMONSTRATION

A. Demonstrate at final inspection that playback of video and storage functions operate properly.

END OF SECTION 28 23 00
CLOSED CIRCUIT TELEVISION

NOTE: THESE SPECIFICATIONS ARE THE PROPERTY OF THE ENGINEER AND ARE NOT TO BE REUSED OR REPRODUCED WITHOUT WRITTEN PERMISSION. THIS SPECIFICATION IS COPYWRITTEN.

SECTION 28 31 00

FIRE ALARM and SMOKE DETECTION SYSTEM

PART 1 GENERAL

1.01 Summary

A. Summary

This performance specification provides the minimum requirements for the Life Safety System. The system shall include, but not limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system to include but not limited to the following functions:

Smoke and fire detection.
Sprinkler suppression system monitoring and control.
Off-Premise notification
Smoke Control.

B. Manufacturer

The manufacturer of the system equipment shall be regularly involved in the design, manufacture, and distribution of all products specified in this document. These processes shall be monitored under a quality assurance program that meets the ISO 9000 requirements.

All System components shall be the cataloged products of a single supplier. All products shall be listed by the manufacturer for their intended purpose.

Notifier products, distributed by Video-Tech-Tronics Inc., Grand Rapids, MI constitute the minimum type and quality of equipment to be installed.

All control panel assemblies and connected field appliances shall be both designed and manufactured by the same company, and shall be tested and cross-listed as to ensure that a fully functioning is designed and installed. The system supplied under this specification shall be a microprocessor-based, system. The system shall utilize independently addressed, microprocessor-based smoke detectors, heat detectors, and modules as described in this specification.

Products of the following manufacturers, using the control equipment named, may be utilized provided they meet all requirements of the specifications:

Notifier Model ONYX 640 by Video-Tech-Tronics. Contact person is Jeff VanSkiver 616 785-3700, jvanskiver@videotechtronics.com

C. Alternates

Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building owner. All specified operational features must be met without exception.

The authorized representative of the manufacturer of the major equipment shall be responsible for the satisfactory installation of the complete system.

All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling system, access control, and smoke control. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

All control panel assemblies and connected field appliances shall be provided by the same system supplier, and shall be designed and tested to ensure that the system operates as specified. The system shall utilize independently addressed, microprocessor-based smoke detectors, heat detectors, as described in this specification.

All equipment and components shall be installed in strict compliance with the manufacturer's recommendations.

The equipment to be supplied will be considered only if it meets all sections of the performance specification. Any deviations of system performance outlined in this specification will only be considered when the following requirements have been met:

A complete description of proposed alternate system performance methods with three (3) copies of working drawings thereof for approval by the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.

The supplier shall furnish evidence that the proposed or alternate system performance is equal or superior to the system operation stated in the specification. Such evidence shall be submitted to and accepted by the Owner, not less than ten (10) calendar days prior to the scheduled date for submission of bids.

The supplier shall submit a point-by-point statement of compliance for all sections in this specification. The statement of compliance shall consist of a list of all paragraphs within these sections. Where the proposed system complies fully with the paragraph as written, placing the word "comply" opposite the paragraph number shall indicate such. Where the proposed system does not comply with the paragraph as written and the supplier feels the proposed system will accomplish the intent of the paragraph, a full description of the function as well as a full narrative description of how its proposal will meet its intent shall be provided. Any submission that does not include a point by point statement of compliance as described herein shall be disqualified. Where a full description is not provided, it shall be assumed that the proposed system does not comply.

The acceptability of any alternate proposed system shall be the sole decision of the Owner or his authorized representative.

1.02 References

A. Codes

1. Fire

The equipment and installation shall comply with the current provisions of the following codes and standards:

NFPA 70 - 2002 National Electric Code®
NFPA 72 - 1999 National Fire Alarm Code®
NFPA 90A - 1999 Air Conditioning Systems
NFPA 92A - 2000 Smoke Control Systems
NFPA 92B - 2000 Smoke Management Systems in Malls, Atria, and Large Areas
NFPA 101- 2000 Life Safety Code®

UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
UL 268A - Smoke Detectors for Duct Applications.
UL 217 – Single and Multiple Station Smoke Alarms
UL 521 – Heat Detectors for Fire Protective Signaling Systems.
UL 228 – Door Closers-Holders, With or Without Intergal Smoke Detectors.
UL 464 – Audible Signaling Appliances.
UL 38 - Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems.
UL 346 – Water Flow Indicators for Fire Protective Signaling Systems.
UL 1971 - Signaling Devices for the Hearing-Impaired.
UL 1481 - Power Supplies for Fire Protective Signaling Systems.
UL 1711 – Amplifiers for Fire Protective Signaling Systems.
UL 1635 – Digital Alarm Communicator System Units.

Michigan Bureau of Construction Codes and Fire Safety
Federal Codes and Regulations

Americans with Disabilities Act (ADA)

International Standards Organization (ISO)
ISO-9000
ISO-9001

European Union (EU)
EMC Directive 89/336/EEC

Electromagnetic Compatibility Requirements

1.03 Definitions and Abbreviations

A. Definitions

ADA: Americans with Disabilities Act.
AFF: Above Finished Floor.
AHJ: Authority Having Jurisdiction.
Approved: Unless otherwise stated, materials, equipment or submittals approved by the Authority or AHJ.
Circuit: Wire path from a group of devices or appliances to a control panel or transponder.
CPU: The central computer of a multiplex fire alarm or voice command control system.
FACP: Fire Alarm Control Panel.
HVAC: Heating Ventilating and Air Conditioning.
IDC: Initiating Device Circuit.

LED: Light Emitting Diode.
LCD: Liquid Crystal Display.
NFPA: National Fire Protection Association.
NAC: Notification Appliance Circuit.
PTR: Printer.
SLC: Signaling Line Circuit.
Style 1: As defined by NFPA 72, Class B.
Style 4: As defined by NFPA 72, Class B.
Style 6: As defined by NFPA 72, Class A.
Style 7: As defined by NFPA 72, Class A.
Style B: As defined in NFPA 72, Class B.
Style D: As defined in NFPA 72, Class A.
Style Y: As defined in NFPA 72, Class B.
UL or ULI: Underwriters Laboratories, Inc.
UL Listed: Materials or equipment listed and included in the most recent edition of the UL Fire Protection Equipment Directory.
Zone: Combination of one or more circuits or devices in a defined building area, i.e. 3 speaker circuits on a floor combined to form a single zone.

1.04 System Description

A. General

1. General

The Contractor shall furnish all labor, services and materials necessary to furnish and install a complete, functional fire alarm system (System). The System shall comply in respects with all pertinent codes, rules, regulations and laws of the Authority, and local jurisdiction. The System shall comply in all respects with the requirements of the specifications, manufacturer's recommendations and Underwriters Laboratories Inc. (ULI) listings.

Special attention must be given to the audibility requirements of the Michigan Building Code 2006 and NFPA 72, 2005. It is the responsibility of the contractor to comply with this requirement whether or not sufficient devices are shown on the drawings.

It is further intended that upon completion of this work, the Owner be provided with:

Complete information and drawings describing and depicting the entire system(s) as installed, including all information necessary for maintaining, troubleshooting, and/or expanding the system(s) at a future date.

Complete documentation of system(s) testing.

Certification that the entire system(s) has/have been inspected and tested, is/are installed entirely in accordance with the applicable codes, standards, manufacturer's recommendations and ULI listings, and is/are in proper working order. Contractor shall use "Fire Alarm System Certification and Description" as required by Section 1-6.2 of NFPA 72 - 1999 edition
2. Description

B. Project Submittal

The contractor shall purchase no equipment for the system specified herein until the owner has approved the project submittals in their entirety and has returned them to the contractor. It is the responsibility of the contractor to meet the entire intent and functional performance detailed in these specifications. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications.

Each submittal shall include a cover letter providing a list of each variation that the submittal may have from the requirements of the contract documents. In addition the contractor shall provide specific notation on each shop drawing, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.

All drawings and diagrams shall include the Contractor's title block, complete with drawing title, contractor's name, address, date including revisions, and preparer's and reviewers initials

Shop Drawings
A complete set of shop drawings shall be supplied. The shop drawings shall be reproduced electronically in digital format. This package shall include but not be limited to:

Control panel wiring and interconnection schematics.
Complete point to point wiring diagrams.
Riser diagrams.
Battery calculations
All drawings shall be reviewed and signed by an individual having a minimum of a NICET level IV certification in fire protection engineering technology, subfield of fire alarm systems. This individuals name and NICET certification number shall be listed on the drawings.

B. Sequence of Operations

1. General

The alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler water flow switch, the following functions shall automatically occur:

The internal audible device shall sound at the control panel and remote annunciator.
The LCD display shall indicate all applicable information associated with the alarm condition including; zone, device type, device location and time/date.
All system activity/events shall be documented in system history and on the system printer.
Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
Activate notification audible appliances throughout the building including the sounders in all resident apartment smoke detectors.
Activate visual strobes notification appliances throughout the building.
Transmit signal to the central station with point identification.
All automatic events programmed to the alarm point shall be executed and the associated outputs activated.

All self-closing fire/smoke doors held open shall be released

Alarm activation of any apartment smoke detector shall cause the sounder in that detector and all other detectors in that apartment to operate. Apartment detector alarm shall cause a supervisory signal on the fire alarm control panel, light an LED on the panel and report the event to the central station monitoring the system. The central station transmission shall indicate the type of alarm and the apartment involved.

2. Duct Smoke Operation-Alarm

The Alarm activation of any duct smoke detector, the following functions shall automatically occur:

The internal audible device shall sound at the control panel and remote annunciator.
The LCD display shall indicate all applicable information associated with the alarm condition including; zone, device type, device location and time/date.
All system activity/events shall be recorded in system history file.
Any remote or local annunciator LED's associated with the alarm zone shall be illuminated.
Transmit signal to the central station with point identification.
Shutdown the local air handling unit.
All automatic events programmed to the alarm point shall be executed and the associated outputs activated. At the option of the engineer duct smoke detector activation may be programmed to cause a supervisory signal at the fire alarm control panel, report to the central station as a supervisory condition, and not activate the alarm notification appliances

3. Supervisory Operation

Upon supervisory activation of any sprinkler valve supervisory switch, the following functions shall automatically occur:

The internal audible device shall sound at the control panel and remote annunciator.
The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date.
All system activity/events shall be documented in system history file.
Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.
Transmit signal to the central station with point identification.

4. Trouble Operation

Upon activation of a trouble condition or signal from any device on the system, the following functions shall automatically occur:

The LCD display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.
All system activity/events shall be documented in system history file.
Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
Transmit signal to the central station with point identification.

5. Monitor Activation

Upon activation of any device connected to a monitor circuit, the following functions shall automatically occur:

The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.
Any remote or local annunciator LCD/LED's associated with the status zone shall be illuminated.

C. System Configuration

1. General

All Life Safety System equipment shall be arranged and programmed to provide a system for the early detection of fire, the notification of building occupants, the automatic summoning of the local fire department, the override of the HVAC system operation, and the activation of other auxiliary systems to inhibit the spread of smoke and fire, and to facilitate the safe evacuation of building occupants.

2. Power Supply

Standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for 24 hours and capable of operating the system for 5 minutes in the alarm mode at 100% load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.

3. Display

The main display interface shall show the last two most recent highest priority system events without any operator intervention. All system events shall be directed to one of four message queues. Messages of different types shall never be intermixed to eliminate operator confusion. A "Help" switch shall provide additional information about any device highlighted by the operator.

4. Notification Appliance Circuits

Notification appliance circuits (NAC) shall be Class B (Style "Y"). All notification appliance circuits shall have a minimum circuit output rating of 2 amperes @ 24 vdc. The notification circuits shall be power limited. Non-power limited circuits are not acceptable.

5. Signaling Line Circuits

The signaling line circuit shall communicate from a panel/node to analog/addressable detectors, input modules, output modules, isolation modules and notification appliance circuits.

Each signaling circuit shall provide a minimum of 20 spare addresses.

When a signaling line circuit covers more than one fire/smoke compartments, a wire-to-wire short shall not effect the operation of the circuit from the other fire/smoke compartments.

The signaling line circuit (SLC) connecting panels and annunciators shall be Class B (style 4).

The signaling line circuit connecting to addressable/analog devices including, detectors, monitor modules, control modules, isolation modules, and notification circuit modules shall be Class B (style 4).

6. DACT

The off premise connection shall be capable of transmitting all system events to a central monitoring station. System events shall be reported by individual point, e.g., waterflow alarm second floor west riser. Each connection shall allow multiple formats allowing facility events to transmit to multiple receivers.

1.05 Submittals

A. Project Submittal

The contractor shall purchase no equipment for the system specified herein until the owner has approved the project submittals in their entirety and has returned them to the contractor. It is the responsibility of the contractor to meet the entire intent and functional performance detailed in these specifications. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications. The contractor shall submit three (3) complete sets of documentation within 30 calendar days after award of purchase order.

Each submittal shall include a cover letter providing a list of each variation that the submittal may have from the requirements of the contract documents. In addition the contractor shall provide specific notation on each shop drawing, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.

All drawings and diagrams shall include the Contractor's title block, complete with drawing title, contractor's name, address, date including revisions, and preparer's and reviewers initials

Product Data
Data sheets with the printed logo or trademark of the manufacturer for all equipment. Indicated in the documentation will be the type, size, rating, style, and catalog number for all items proposed to meet the system performance detailed in this specification. The proposed equipment shall be subject to the approval of the Architect/Engineer.

Shop Drawings
A complete set of shop drawings shall be supplied. The shop drawings shall be reproduced electronically in digital format. This package shall include but not be limited to:

Control panel wiring and interconnection schematics.

Complete point to point wiring diagrams.
Riser diagrams.
Complete floor plan drawing locating all system devices and 1/8” = 1'-0 scale plan.
Detailed system operational description. Any Specification differences and deviations shall be clearly noted and marked.
Complete system bill of material.
All drawings shall be reviewed and signed off by an individual having a minimum of a NICET certification in fire protection engineering technology, subfield of fire alarm systems.

Quality Assurance/Control Submittals
Installer's Certification

The engineered systems distributor must be licensed in the state of project location and have been incorporated in the business in that state for a minimum of 5 years.
Submit a copy of the contractors training certification issued by the manufacturer of the Life Safety System.
A copy of the installing technician's NICET certification.

System Calculations
Complete calculations shall be provided which show the electrical load on the following system components:
Each system power supply, including stand alone booster supplies.
Each standby power supply (batteries).
Each notification appliance circuit.
Each auxiliary control circuit that draws power from any system power supply.

B. Closeout Submittal

Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. The close out submittals shall include:

Project specific operating manuals covering the installed Life Safety System. A generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.

As-Built drawings consisting of: a scaled plan of each building showing the placement of each individual item of the Life Safety System equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically documented by the system.

Provide all drawings shall be provided in standard .DXF format. A vellum plot of each sheet shall also be provided.

The application program listing for the system as installed at the time of acceptance by the building owner and/or local AHJ (disk, hard copy printout, and all required passwords).

Provide the name, address and telephone of the authorized factory representative.

A filled out Record of Completion similar to NFPA 72, 1999 edition figure 1-6.2.1.

1.06 Quality Assurance

A. Qualification of Contractors

1. Qualifications of Contractor

The contractor shall have successfully installed similar system fire detection, signaling control components on a previous project of comparable size and complexity. The owner reserves the right to reject any control components for which evidence of a successful prior installation performed by the contractor cannot be provided.

The contractor shall have in-house engineering and project management capability consistent with the requirements of this project. Qualified and approved representatives of the system manufacturer shall perform the detailed engineering design of central and remote control equipment. Qualified and approved representatives of the system manufacturer shall produce all panel and equipment drawings and submittals, operating manuals. The contractor is responsible for retaining qualified and approved representative(s) of those system manufacturers specified for detailed system design and documentation, coordination of system installation requirements, and final system testing and commissioning in accordance with these specifications.

PART 2 PRODUCTS

2.01 Manufacturer

A. Manufacturer

Acceptable fire alarm system manufacturers include:
Notifier.

All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approval agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.

2.02 Field-mounted system components

A. Initiating Devices

1. Smoke Detectors & Accessories

a. Analog Addressable Smoke -- General

Each analog addressable smoke detector's sensitivity shall be capable of being programmed individually as: most sensitive, more sensitive, normal, and less sensitive or least sensitive. In addition to the five sensitivity levels the detector shall provide a prealarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value.
An alternate alarm sensitivity level shall be provided for each detector, which can be set to any of the five (5) sensitivity settings manually or automatically using a time of day event. In addition to the five alternate sensitivity levels the detector shall provide an alternate prealarm sensitivity setting, which shall be settable in 5% increments of the detector's alternate alarm sensitivity value.
The detector shall be able to differentiate between a long drift above the prealarm threshold and fast rise above the threshold.
The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be compared against its reference value. The detector shall provide a maintenance alert signal that 75% to 99% compensation has been used. The detector shall provide a dirty fault signal that 100% or greater compensation has been used.
The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.

b. Smoke Detector – Multi-Sensor Photo Thermal

Provide analog/addressable multisensor smoke detectors at the locations shown on the drawings. Alarm condition shall be based upon the combined input from the photoelectric and thermal detection elements. Separately mounted photoelectric detectors and heat detectors in the same location, clustered at the manufacturer's listed spacing is an acceptable alternative. The detector shall have the ability to set the sensitivity and alarm verification of each individual detector on the circuit. It shall be possible to automatically set the sensitivity of individual analog/addressable detectors for the day and night periods.

Each smoke detector shall be capable of transmitting prealarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient environmental thresholds approximately six times an hour. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.

c. Smoke Detector – Photoelectric
Provide analog/addressable photoelectric smoke detectors at the locations shown on the drawings. The detector shall have the ability to set the

sensitivity and alarm verification of each of the individual detectors on the circuit. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient environmental thresholds approximately six times an hour. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.

2. Heat Detectors

a. Fixed Temperature-ROR Heat Detector

Provide analog/addressable combination fixed temperature / rate-of-rise detectors at the locations shown on the drawings. The heat detector shall have a nominal fixed temperature alarm point rating of 135℉ (57℃) and a rate of rise alarm point of 15℉(9℃) per minute. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.

3. Detector Bases

a. Detector Base - Standard

Provide standard detector mounting bases suitable for mounting on either North American 1-gang, 3½ or 4 inch octagon box and 4 inch square box, or European BESA or 1-gang box. The base shall, contain no electronics and support all series detector types.

4. Manual Stations

a. Manual Station - Double Action Single Stage

Provide analog/addressable double action, single stage fire alarm stations at the locations shown on the drawings. The fire alarm station shall be of polycarbonate construction and incorporate an internal toggle switch. A locked test feature shall be provided. The station shall be finished in red with silver "PULL IN CASE OF FIRE" lettering. The manual station shall be suitable for mounting on North American 2 ½ (64mm) deep 1-gang boxes and 1 ½ (38mm) deep 4 square boxes with 1-gang covers.

5. Horn-Strobes

a. Provide low profile wall mount horn/strobes at the locations shown on the drawings. The
horn/strobe shall provide an audible output of 84 dBA at 10ft. when measured in reverberation room per UL-464. Strobes shall provide synchronized flash outputs. The strobe output shall be determined as required by it’s specific location and application from a family of 15cd, 30cd,

60cd, 75cd & 110cd devices. The horn shall have a selectable steady or synchronized temporal output. In and out screw terminals shall be provided for wiring. Low profile horn/strobes shall mount in a North American 1-gang box.

6. Strobes

a. Low Profile Strobes
Provide low profile wall mounted strobes at the locations shown on the drawings. In and out screw terminals shall be provided for wiring. Strobes shall provide synchronized flash outputs. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 60cd, 75cd, or 110cd devices.

PART 3 EXECUTION

3.01 Installation

A. General

All equipment shall be attached to walls and ceiling/floor assemblies and shall be mounted firmly in place. Detectors shall not be supported solely by suspended ceilings. Fasteners and supports shall be sized to support the required load.

B. Installation Sequence

Installation of the systems shall be conducted in stages and phased such that circuits and equipment are installed in the following order:

- Riser conduits, AC power conduits and control cabinets.
- Wiring for complete notification circuits and appliance installation throughout facility.
- Pre-test the audible and visual notification appliance circuits.
- Install all new detection devices.
- Terminations between field devices and the associated control equipment.
- The detection system shall be switched over and end of each day the system shall be operational. At no time will the system be placed out of service over night.
- Complete the interface to the building automation system.
- Complete contractor pre-test of system.
- Complete system testing.

C. Conductors

The requirement of this section apply to all system conductors, including all signaling line, initiating device, notification appliance, auxiliary function, remote signaling, AC and DC power and grounding/shield drain circuits, and any other wiring installed by the Contractor pursuant to the requirements of these Specifications.

All circuits shall be rated power limited in accordance with NEC Article 760.

All signaling line circuits, including all addressable initiating device circuits shall be 18 AWG minimum multi-conductor jacketed twisted cables or twisted shielded or as per manufacturer's requirements.

All non-addressable initiating device circuits, 24 VDC auxiliary function circuits shall be 18 AWG minimum or per manufacturer's requirements.

All audible notification appliance circuits shall be 14 AWG minimum twisted pairs or twisted pairs shielded or per manufacturer's requirements.

All visual notification appliance circuits shall be 14 AWG minimum THHN or twisted pairs or twisted shielded pairs or per manufacturer's requirements.

Power-limited cable in accordance with NEC 70, where used, not installed in UL listed metal conduit or raceway shall be mechanically protected by building construction features.

The contractor shall neatly tie-wrap all field-wiring conductors in the gutter spaces of the control panels and secure the wiring away from all circuit boards and control equipment components. All field-wiring circuits shall be neatly and legibly labeled in the control panel. No wiring except home runs from life safety system circuits and system power supply circuits shall be permitted in the control panel enclosures. No wiring splices shall be permitted in a control panel enclosure.

All penetration of floor slabs and firewalls shall be fire stopped in accordance with all local fire codes.

D. Conductors and Raceway

Except as otherwise required by Code and/or these Specifications, the installation of all system circuits shall conform to the requirements of Article 760 and raceway installation to the applicable sections of Chapter 3 of NFPA 70 - 1996, National Electrical Code. Fire alarm circuit wiring shall include all circuits described in Section 760-1 including Fine Print Note No. 1 (FPN No. 1), and as defined by the manufacturer's UL listing.

The entire system shall be installed in a skillful manner in accordance with approved manufacturer's installation manuals, shop drawings and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type required by the NEC and approved by local authorities having jurisdiction for the purpose.

Any shorts, opens, or grounds found on new or existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

The contractor shall neatly tie-wrap all field-wiring conductors in the gutter spaces of the control panels and secure the wiring away from all circuit boards and control equipment components. All field-wiring circuits shall be neatly and legibly labeled in the control panel. No wiring except home runs from life safety system circuits and system power supply circuits shall be permitted in the control panel enclosures. No wiring splices shall be permitted in a control panel enclosure.

All penetration of floor slabs and firewalls shall be fire stopped in accordance with all local fire codes.

E. Open Cable

Power-limited cable in accordance with NEC 70, where used, not installed in UL listed metal conduit or raceway shall be mechanically protected by building construction features:

Installation shall be in areas not subjected to mechanical injury.

All circuits shall be supported by the building structure. Cable shall be attached by straps to the building structure at intervals not greater than 10 feet. Wiring installed above drop ceilings, cable shall not be laid on ceiling tiles. Cable shall not be fastened in a manner that puts tension on the cable.

Cable type shall be FPLP, FPLR or FPL, or permitted substitutions, selected for the installation application as required by NEC 70, Section 760-61.

All cable that is not enclosed by conduit shall be supported and anchored with nylon straps or clamps. The use of staples is prohibited.

F. Conduit Raceway

All systems and system components listed to UL864 Control Units for Fire Protective Signaling Systems maybe installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System(s)or system components not listed to the UL864 standard shall utilize a separate conduit raceway system for each of the sub-systems.

The requirements of this section apply to all system conduits, raceways, electrical enclosures, junction boxes, pull boxes and device back boxes.

All system conduits shall be of the sizes and types specified.

All system conduits shall be EMT, 3/4 -inch minimum, except for flexible metallic conduit used for whips to devices only, maximum length 6 feet, 3/4-inch diameter, minimum.

All system conduits, which are installed in areas, which may be subject to physical damage or weather, shall be IMC or rigid steel, 3/4 -inch minimum.

Conduits shall be sized according to the conductors contained therein. Cross sectional area percentage fill for system conduits shall not exceed 40%.

Provide all new conduit raceway and conduit riser.

All fire alarm conduit systems shall be routed and installed to minimize the potential for physical, mechanical or by fire damage, and so as not to interfere with existing building systems, facilities or equipment, and to facilitate service and minimize maintenance.

All conduits, except flexible conduit whips to devices, shall be solidly attached to building structural members, ceiling slabs or permanent walls. Conduits shall not be attached to existing conduit, duct work, cable trays, other ceiling equipment, drop ceiling hangers/grids or partition walls, except where necessary to connect to initiating, notification, or auxiliary function devices.

All system conduits, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device back boxes shall be readily accessible for inspection, testing, service and maintenance.

3.02 Warranty and Maintenance

A. Warranty

The contractor shall warranty all materials, installation and workmanship for one (1) year from date of acceptance, unless otherwise specified. A copy of the manufacturer's warranty shall be provided with close-out documentation and included with the operation and installation manuals.

The System Supplier shall maintain a service organization with adequate spare parts stock within 75 miles of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the owner notifying the contractor.

3.03 Training

A. Training

The System Supplier shall schedule and present a minimum of 4 hours of documented formalized instruction for the building owner, detailing the proper operation of the installed System.

The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.

The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

Instruction shall be made available to the Local Municipal Fire Department if requested by the Local Authority Having Jurisdiction.

END OF SECTION 28 31 00
FIRE ALARM and SMOKE DETECTION SYSTEM

NOTE: THESE SPECIFICATIONS ARE THE PROPERTY OF THE ENGINEER AND ARE NOT TO BE REUSED OR REPRODUCED WITHOUT WRITTEN PERMISSION. THIS SPECIFICATION IS COPYWRITTEN.

SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.1 Related Documents

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. This work includes furnishing all labor, material, equipment and supervision to excavate, backfill and compact fill as shown on the drawings.

PART 2 - PRODUCTS

2.1 Materials

A. Topsoil-Surface soils containing organic matters and productive of plant life.

B. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

C. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

D. Unsatisfactory Soils: ASTM D 2487 Soil Classification Groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or any combination of these group symbols.

PART 3 - EXECUTION

3.1 Preparation

A. Clearing and Grubbing

1. Remove trees and shrubs indicated on the plans as required to complete work. Grub out all roots to a depth of 2 feet below finished grade.

2. Remove from site all debris resulting from clearing and grubbing.

B. Topsoil

1. Remove topsoil.

3.2 Utilities

A. Before starting excavation, establish location and extent of underground utilities occurring in work area.

B. Notify utility companies to remove and relocate lines which are in way of excavation.

C. Protect utility services uncovered by excavation.

3.3 Backfill and Fill

A. Placement and Compaction

1. Place backfill and fill material in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

2. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy.

3. Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

B. Density Requirements

1. Compact soil to not less than the following percentages of maximum density in accordance with ASTM D1557.

2. Compact top 12 inches of subgrade and each layer of backfill or fill material at 95 percent maximum dry density.

C. Moisture Control

1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer or soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

2. Remove and replace, or scarify and air dry soil material that is too wet to permit compaction to specified density.

3.4 Quality Control

A. The Testing Agency will inspect, test and approve all areas requiring compaction during construction and prior to subsequent work being started.

B. The Testing Agency will perform the following test:

1. Test compaction of each lift, or portion thereof, at locations not more than 50 feet on center.

2. Tests shall be performed in accordance with ASTM D2922 and D3017 or other approved methods. Test reports shall be submitted to the Engineer and the Contractor.

3.5 Maintenance

A. Reconditioning Compacted Areas

1. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

B. Settlement

1. Where settling is measurable or observable at excavated areas during general project warranty period, remove surface, add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.7 Excess and Waste Materials

A. Remove excess and waste materials, including unacceptable excavated material, trash and debris, and dispose of.

3.8 Surplus Materials

A. Surplus removed, excavated, or unsuitable material becomes the property of Contractor.

B. Dispose of surplus or unsuitable materials off-site.

END OF SECTION 31 00 00
EARTHWORK

SECTION 31 00 00

EXCAVATING and BACKFILL

PART 1 - GENERAL

1.1 Related Documents

A. Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. The work of this Section shall include excavation, preparation of subgrade and placement of backfill, final grading, placement of topsoil and removal of excess material.

1.3 Related Work

A. The following work is related to this Section:

1.	Soil boring data: Contact the Architect to obtain a copy of the soils report.	
2.	Section 01 40 05	Testing Laboratory Requirements
3.	Division 2	
4.	Division 23	Excavating and backfilling required for mechanical services
5.	Division 26	Excavating and backfilling required for electrical services

1.4 Site Conditions

A. Protect existing facilities, utilities, pavement, streets, and adjacent buildings. Repair damaged items at no cost to the Owner.

B. Remove remnants of previous buildings, including concrete walls, brick walls, concrete slabs, foundations, and piping to the extent necessary to allow construction in accordance with the Contract Documents.

C. Provide temporary construction dewatering as required to maintain dry excavations.

PART 2 - PRODUCTS

2.1 On-Site Excavated Materials Used for Backfill

A. Suitable granular materials removed from excavations and free from organic materials, vegetation, rubbish and cinders, may be used for fills and backfills as approved by the Soil Engineer. Stockpile on the site until used.

B. Dispose of excess and unsuitable materials off site in a legal manner.

2.2 Off-Site Fill Material Used for Backfill

A. Use whenever on-site excavated materials are not sufficient either in supply or quality. Material shall be capable of being compacted to specification requirements.

1. Submit representative 50 lb. samples of each type of fill material to the Soil Engineer for approval prior to incorporating such material into the Work.

2.3 General

A. Material to be placed shall be free of rock or stone larger than 2 inches in the largest dimension. Recycled concrete of any size is not considered acceptable back fill.

B. Drainage Aggregate, where indicated on the drawings, consists of crushed stone or crushed gravel with 100 percent passing the 1-1/2" sieve and no more than 5% passing the #4 sieve and no more than 2% passing the #200 sieve.

C. Granular fill, where indicated on the drawings, consists of granular soil with not less than 90 percent passing the 3/4 inch sieve nor more than 2 percent passing the #200 sieve. Rocks larger than 2 inches are not permitted.

D. Test Fill in accordance with ASTM C136 and ASTM C117.

E. Temporary and Permanent Excavation Support System: As required, See Section 31 30 00.

PART 3 - EXECUTION

3.1 Inspection

A. Inspect area to receive the work and report immediately in writing to the Engineer, as required in the General Conditions, any unacceptable conditions. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner. Commencement of work implies acceptance of related work.

3.2 General

A. Locate Existing Utilities in Areas of Work.

B. Remove any existing below-grade obstruction which interferes with the new work. Remove all such obstructions to provide at least 24 inch clearance from new grading. Cap or plug abandoned utilities as required per utility requirements.

C. Protect existing service lines and utilities which are to remain in place within excavated areas. Repair any damaged utilities to the satisfaction of the utility company.

D. Excavate materials to dimensions and elevations indicated. Take appropriate measures to prevent slope failures of the sides of excavations.

E. Extend excavations a sufficient distance from walls to allow for forming and shoring, installation of services, and inspection.

F. Barricade open excavations and post with warning lights. Protect adjacent structures from damage due to excavation operations.

G. Include removal of rock and boulders.

1. Rock classification: Only solid rock in ledges, bedded deposits or conglomerate deposits so firmly cemented as to present all the characteristics of solid rock, and which cannot be removed with a 3/4 cubic yard capacity power shovel without drilling and blasting, shall be excluded from the work of this Section: boulders having a volume of 1/2 cubic yard or more shall also be excluded from the Work of this Section.

2. Contact the Architect before proceeding with any rock removal.

H. Excavate to produce an undisturbed soil surface at the required elevation with a plane variation of ± one inch. Excavate with power equipment to not lower than six inches above bottom of footings: excavate remaining by hand to produce a smooth, level substrate. Power excavate to four inches below bottom of slabs on grade.

I. Excavate areas to afford adequate drainage. Remove all water in areas of construction and provide all sumps, pumps, electric power and attendance required.

J. All footing sub-grades shall be inspected by the Soil Engineer before proceeding with construction. The contractor will notify the Soil Engineer so that the tests may be scheduled and performed by the Soil Engineer.

1. If the actual bearing capacity of the soil is found to be less than the bearing capacity used for the footing design, defer placing of concrete.

2. The Soil Engineer shall evaluate the test results and notify the Architect. The Architect will inform they Contractor, in writing, on the proper course of action.

3. All changes to the Contract Documents required by the Soil Engineer shall be made by appropriately issued Change Orders by the Architect.

K. When suitable bearing soil is encountered at the sub-grade elevations indicated and the excavation is made to greater depth, locate footing at the lower excavated level on undisturbed subgrade.

L. During all earth work operations, water the surfaces in the working area at frequent intervals and only in sufficient quantities to control dust.

M. The use of explosives is not permitted.

N. Protect excavation bottoms from freezing when temperature is less than 32 degrees F.

3.3 Shoring and Bracing

A. Provide sheet piling, soldier pile and tie backs/uprights, stringers, and cross braces for shoring and bracing as required.

B. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

C. Provide shoring and bracing where excavations exceed four (4) feet in depth or the sides of the excavation exceed a 1 to 1 slope.

D. Maintain shoring and bracing in excavations while excavations are open.

E. Carry down shoring and bracing as excavation progresses.

3.4 Filling and compacting

A. Backfill interior overdig and wherever slabs abut foundations and columns with approved backfill. Backfill only after walls are properly braced to resist the imposed loading and other required construction has been completed and approved.

B. Place fill materials in horizontal loose layers to produce a uniform thickness of material. Start in the deepest area and progress approximately parallel to the finished grade.

1. Thickness of layers before compaction shall not exceed eight inches.

2. Do not place fill layers until the preceding fill layer has been approved by the Soil Engineer.

C. Do not place material in areas which have not been approved. Do not place fill materials on sub-grades where water is present or on frozen sub-grades. Do not use frozen materials for any of the Work.

D. Compact each layer of cohesionless material to achieve the following percentages of relative density as determined by ASTM D1557 - Modified Proctor Method:

1. Under building slabs supported on grade, 12 inches of blended fill compacted to 95 percent.

2. Under paving and walks, 90 percent.

3. Under areas of general grading and exterior mechanical and electrical backfilling, 90 percent.

E. Place leveling bed under slab in thickness as indicated, but in no case less than six inches. Compact fill with vibratory or tamping methods to knit the stone into a firm base.

3.5 Unit Prices.

A. State in the Bid Form the unit cost per cubic yard (in-place volume) for soil excavation and disposal when over-excavation of unsuitable material is required.

B. State in the Bid Form the unit cost per cubic yard (in-place volume) for furnishing and placing compacted crushed stone or gravel drainage aggregate when additional fill is required beyond that described in the Contract Documents.

C. State in the Bid Form the unit cost per cubic yard (in-place volume) for furnishing and placing granular compacted sand fill when additional fill is required beyond that described in the Contract Documents.

D. State in the Bid Form the unit cost per cubic yard for rock and obstruction removal.

END OF SECTION 31 00 00
EXCAVATING and BACKFILL

SECTION 31 00 00.2

EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION:

A. The work includes earthwork for foundations, floor slabs, miscellaneous exterior concrete, asphalt pavements, yard piping and rough site grading.

1.02 REFERENCES:

A. MDOT - Michigan Department of Transportation, "Standard Specifications for Construction," 2003 ed.

B. American Society of Testing Materials, latest edition.

1.03 DEFINITIONS:

B. Optimum Moisture - Percentage of water at maximum density.

C. Borrow - material required for earthwork construction in excess of the quantity of suitable material available from required excavation grading or cutting. Borrow may be necessary even though not shown on the plans.

D. Suitable Excavated Material - mineral (inorganic) soil free of cinders, refuse, sod, boulders, rocks, pavement soft or plastic clays, vegetable or other organic material capable of being compacted as specified. Moisture content has no bearing on the suitability of materials to be used.

E. Granular Material - Coarse grained materials having no cohesion, which derive their resistance to displacement from internal stability.

F. Cohesive Material - Fine grained material which produces resistance to displacement by mutual attraction between particles. Clays are cohesive.

G. Rough Grade - earth grade before placing structure or landscaping.

H. Subgrade - earth grade upon which a pavement structure is to be placed.

I. Rock Excavation: - Boulders or rock weighing 4,000 pounds (approximately one cubic yard) or more and all solid or ledge rock, slate, shale sandstone and other hard materials that require continuous use of pneumatic tools, heavy rippers or continuous drilling and blasting for removal. Pavements are not included.

J. Proof Rolling - applying test loads over the rough grade or subgrade surface by means of a heavy pneumatic tire roller or other approved means, to locate and permit timely correction of deficiencies likely to adversely affect performance of the pavement structure.

1.04 JOB CONDITIONS:

A. If during progress of the work, testing indicates that materials do not meet specified requirements, remove defective work and replace at no cost to the OWNER.

B. Protect and preserve all public and private property including existing vegetation, landscape features, monuments within, along and adjacent to the work area.

C. Moisture content has no bearing on the suitability of material to be used.
   1. The moisture content of a material, however, may be such that its use will require extensive manipulation to achieve required compaction.
   2. It is the contractor's responsibility to determine the economics of using or disposing and replacing of such materials.
   3. Materials determined by the contractor to be uneconomical for use may be disposed of off-site or on-site in areas approved by the ENGINEER and replaced with other material at no additional cost to the OWNER.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Fill:
   1. Granular Material: MDOT 902.12, Table 902-3, Class III limited to 2.0 inch maximum size.
   2. Select Granular Material MDOT 902.12, Table 902-3 Class II or IIa limited to 1.0 inch maximum size.
   3. Suitable Excavated Material:
      a. Free of cinders, ashes, refuse, sod, boulders, rocks, pavement, soft or plastic clays, and vegetable or other objectionable organic material and capable of being compacted as specified herein.
      b. Moisture content has no bearing on the suitability of materials.
   4. Clay liner Material: Unified Classification CL, CH, ML, MH.

B. Topsoil: Surface soils containing organic matters and productive of plant life.

C. Pipe Bedding: Compact granular material.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Clearing and Grubbing:
   1. Remove trees and shrubs not indicated to be preserved, as required.
   2. Grub out all roots.
      a. To a minimum depth of 4 feet below finished grade within roadways.
      b. To a minimum depth 2.0 feet below finished grade other location.
   3. Remove all debris from site resulting from clearing and grubbing.

B. Topsoil: Remove from all areas of new construction and stockpile on site in designated areas.

C. Utilities:

1. Before starting excavation establish location and extent of underground utilities occurring in work area.
2. Notify utility companies to remove and relocate lines which are in conflict with design locations.

D. Protect Plantings and other features to remain as part of final landscaping.

3.02 EXCAVATION:

A. Excavate as required for construction of the work. Utilize or dispose of excavated materials as required.
1. Protect excavation by shoring, bracing, sheet piling or other methods as required.
2. Remove unsuitable material to firm underlying soils beneath footings, pipelines, floor slabs, paved areas and walks.

B. Preparation of Subgrade:
1. Compact top 12 inches of subgrade under footings, slabs, pavement structure areas and walks to 95% maximum density unless otherwise specified.
2. Compact top 12 inches under landscaped areas to 85% maximum density.

C. Utilities:
1. Maintain, reroute or extend as required, existing utility lines to remain which pass through excavation area.
2. Protect utility services uncovered by excavation.
3. Cap off, plug or seal, discontinued utility services and remove from site within excavated areas.

3.03 FILL:

A. Under Floor Slabs and Exterior Slabs: Select granular material placed in layers maximum 9 inch deep compacted to 95% maximum density.

B. Under Roadways: Suitable excavated material or granular material placed in layers maximum 9.0 inch deep compacted to 95% maximum density.

C. Under Foundations: Select Granular material placed in layers maximum 9.0 inches deep compacted to 95% maximum density.

D. Landscaped Areas: Suitable excavated material or granular material placed in layers maximum 12 inch deep compacted to 85% maximum density.

3.04 ROUGH GRADING:

A. Rough grade to levels, profiles, contours and elevations required for finished grades and surface treatment.

B. Maintain the following, rough grades unless otherwise directed by ENGINEER:
1. Sidewalk - 4 inches below finished grade.
2. Floor slabs and exterior slabs - 6 inches below bottom slab elevation.
3. Pavement surfaces - as shown.
4. Landscape areas - 4 inches below finished grades to receive topsoil.

3.05 PROOFROLL SUBGRADE SURFACE

A. Two complete passes over area to receive pavement structure.

B. Correct deficiencies disclosed during proof rolling:
   1. Fill depressions with compacted material similar to subgrade soil.
   2. Undercut areas not providing satisfactory support for pavement structure
      a. Fill with compact granular material
      b. Place geotextile material when soil below undercut will not satisfactory support construction equipment or when directed by ENGINEER.

3.06 DEWATERING:

A. Provide dry excavations until structures have been placed and fill is complete.

B. Provide and maintain slopes, crowns, ditches and ponds to insure satisfactory surface drainage at all times.
   1. Construct ditches and other drainage facilities necessary to remove ponded water as soon as practical to provide dry work area for progression of the work.
   2. Interruption of surface drainage or underdrainge: Provide temporary drainage facilities until permanent drainage work complete.

3.07 COMPACTION:

A. Properly place and compact all required materials and exert proper control over the moisture content of the material and other details necessary to obtain satisfactory results.
   1. Remove materials that cannot be compacted with manipulation and/or moisture control.
   2. Replace with suitable excavated materials or granular materials at no cost to the OWNER.

B. Correct any deficiencies resulting from insufficient or improper compaction. Retest if required.

C. Provide equipment and personnel for access to test locations when requested by ENGINEER.

D. Moisture - Density Relationship
   1. Cohesive (Clays) Or Granular (Sands) Soils - ASTM D1557 (Modified Proctor).
   2. Granular (Sands) Soils - Michigan Cone Test.

E. Testing: by ENGINEER or OWNER approved independent laboratory.

3.08 SURPLUS MATERIALS:

A. Surplus excavated or unsuitable excavated material becomes the property of the CONTRACTOR.

B. Dispose of surplus or unsuitable excavated materials off site or on-site in areas designated by Engineer.

C. Disposal On Site: In accordance with MDOT 205.03.

END OF SECTION 31 00 00.2
EARTHWORK

SECTION 31 00 05

DISPOSAL

PART 1 - GENERAL

1.1 Related Documents

A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 Work Included

A. The work of this Section shall include providing all equipment, materials, labor and supervision to dispose of all excess excavated material, trash, debris and waste materials.

1.3 Related Work

A. The following work is related to this Section:

1.	Section 02 40 00	Demolition
2.	Section 31 10 00	Site Preparation
3.	Section 31 00 00	Earthwork, Excavating and Backfill

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 Disposal

A. Remove excess excavated material, unacceptable excavated material, trash, debris and waste materials. Dispose of these materials off Owner's property.

B. Haul materials in trucks with tight beds to prevent spillage on streets or highways. Provide drip pans where necessary to prevent spilling

END OF SECTION 31 00 05
DISPOSAL

SECTION 31 30 00

EXCAVATION SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 Related Documents

A. The Conditions of the Contract and the General Requirements are hereby made a part of this section.

1.2 Work Included

A. The work of this section shall include all labor, material, equipment, and related services necessary to furnish and install an excavation support system indicated on the Drawings or specified herein.

B. Excavation support system work includes but is not limited to protection of existing buildings, streets, walks, utilities and other improvements and excavation against loss of ground or caving embankments.

1.3 Related Work

A. The following work is related to this Section:

1. Geotechnical recommendations and soil boring data. Contact the Architect to obtain a copy of the soils report.

2. Division 2 Site Work

1.4 Design Contractor

A. The Contractor, at his own expense, shall employ an engineer, registered in the State which the project is located, to design the excavation support system.

B. The types of excavation support system shall include, but not be limited to, soldier pile and lagging and/or interlocking steel sheeting.

1.5 Inspection and Testing

A. The Contractor, at his expense, shall employ a land surveyor, registered in the State in which the project is located, to survey existing conditions prior to excavation and installation of excavation support systems and to monitor any alternations in existing conditions during these construction activities.

B. The surveyor shall locate horizontal and vertical elevational markers on adjacent buildings and walks and shall establish existing elevational conditions prior to the beginning of excavation support system work.

C. The surveyor shall monitor all elevational markers on a weekly basis during installation of the excavation support system and shall promptly report his findings.

D. Upon completion of the excavation support system, the surveyor shall locate elevational markers on the system at approximately street level elevation and at a distance apart of not more than 60 feet on center; shall establish existing elevation conditions; shall monitor these markers on an every other week basis until the concrete structural frame and backfill and compaction are complete to the adjoining final exterior grade level; first floor level; and shall report his findings promptly.

E. The surveyor shall measure by instrument any visual report of any building or earth movement, or loss of ground retention in the excavation support system; shall measure by instrument any corrective work by the Contractor to arrest or regain any movement or lost ground; shall perform such measurement promptly as the occasion warrants and at the expense of the Contractor; and shall report his findings promptly.

F. The surveyor shall field verify the location of all subsurface utility lines indicated on the Drawings or documented by the utility companies to be within or adjacent to the working zone for installation of the excavation support system, including tie backs, and protect these utilities from interruption or damage.

1.6 Submittals

A. Layout drawings indicating the location, type, size and design of the excavation support system prepared by an engineer, registered in the State in which the project is located, shall be submitted by the Contractor to the Architect for his review. Submittals shall include engineer's certification, design calculations, schedule, methods, procedures and sequence of operations; shall comply with local code requirements; shall comply with recommendations of the soils engineer; and installation of the system shall not commence until after review of the design by the Architect.

B. The surveyor shall prepare a log of all recorded elevations in a manner that will allow immediate comparison of original with subsequent elevations at each required location. The Contractor shall promptly submit copies of the log to the Architect following each new series of entries into the log.

PART 2 - PRODUCTS

2.1 General

A. Provide materials and equipment to meet design requirements of the approved excavation support system and which are salvageable.

PART 3 - EXECUTION

3.1 Inspection

A. Inspect area to receive the work and report immediately in writing to the Architect, Engineer as required in the General Conditions, any unacceptable conditions. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner. Commencement of work implies acceptance of related work.

3.2 General

A. Execute the work with care. Shore, sheet and support excavation and soil as necessary for the safe and proper execution of the work and the protection of existing construction.

B. Protect the site from caving and unacceptable soil movement. Place support systems to clear permanent construction and to permit forming and finishing of concrete surfaces. Adequately brace and anchor system to resist earth and hydrostatic pressures.

C. Maintain excavation support systems until removal can begin in coordination with backfilling operations and until adjacent structures can withstand imposed lateral earth and hydrostatic pressures. Remove system in stages so backfilling and compaction forces act incrementally and within acceptable design levels on existing structures.

D. Remove and salvage all elements of the installed excavation support system.

3.5 Unit Prices

A. State in the Bid Form the unit cost per lineal foot for installing and salvaging the soldier pile and lagging excavation support system when quantity varies from that shown on the Contract Documents.

B. State in the Bid Form the unit cost per lineal foot for installing and salvaging the interlocking steel sheeting excavation support system when quantity varies from that shown on the Contract Documents.

END OF SECTION 31 30 00
EXCAVATION SUPPORT SYSTEMS

SECTION 31 32 11.1

SOIL SURFACE EROSION CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included:

1. Provide permanent and/or temporary erosion and sedimentation control as called for on the plans.

B. Intent and Purpose of Control:

1. Keep disturbed areas small.
2. Stabilize and protect disturbed areas as soon as possible.
3. Keep storm water runoff velocities low.
4. Protect disturbed areas from runoff.
5. Retain sediment within the corridor or site area.

C. Method of Measurement and Basis of Payment:

1. Temporary Measures - Incidental to construction.
2. Permanent Measures - See Proposal for pay item.

1.02 PERMIT:

A. Required:

1. Apply for and obtain from local Soil Erosion/Sedimentation Control Enforcing Agent.
2. Permit fees to be paid by Owner.

1.03 JOB CONDITIONS:

A. Scheduling:

1. Control measures shall be constructed prior to the time construction starts uphill or upstream from the control measure location.
2. Removal and cleanup of temporary control structures: Within one week after control measure is no longer needed.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Seeding:

1. MDOT, Sec. 816.
2. Temporary Measures: MDOT Table 816-2.
3. Permanent Measures: MDOT Table 816-1.

B. Topsoil:

1. Temporary Measures: Not required unless readily available.
2. Permanent Measures: MDOT 816.

C Mulching:

1. Temporary and Permanent Measures: MDOT, 816 Required as specified on plans and/or in Project Specifications.

PART 3 - EXECUTION

3.01 PERFORMANCE:

A. General:

1. Abide with all applicable rules and regulations as established by the State of Michigan and the local governmental unit pursuant to Act 347 P.A. of 1972 as amended. (Soil Erosion and Sedimentation Control Act).
2. Copies of state guidelines "Better Environment thru Soil Erosion and Sedimentation Control" and applicable OWNER'S Specifications may be obtained at no charge from the OWNER.
3. The Unified Keying System for erosion control measures is included with the construction plans. Specific erosion control measures, if required, are indicated on the plans.
4. Even though a specific erosion control measure is not called out on the plans, this does not relieve the contractor from his obligation under the above Act to properly control and/or prevent all erosion caused by the CONTRACTOR's construction operation.

B. Sediment Removal:

1. Take such steps as are necessary to assure the retention and removal of any sediment which enters an existing storm sewer or open ditch along the construction route before said sewer or ditch discharges into a stream or pond.
2. If eroded material is allowed to enter a storm sewer system it shall be the CONTRACTOR's responsibility to see that all catch basins and manholes are cleaned following construction prior to receipt of final payment. Unless the CONTRACTOR can document positively to what extent an existing storm sewer system along the construction area is silted in prior to construction, no credit will be allowed for cleaning the system stem.
3. The CONTRACTOR shall be responsible for maintaining the roadways in a passable condition until the paving is completed. This includes any maintenance necessary for dust control.

C. Soil Erosion and Sedimentation Control Measures:

1. Provide and maintain at least the following temporary soil erosion and sedimentation control measures:
   a. Excavated or borrow material stock-pile.

(1) Place bales of hay or straw around stockpile in a manner to prevent soil erosion from entering the drainage system or leaving the site.

b. Trench backfill in place.
   (1) Place bales of hay or straw across trenches, ditches and around inlets to prevent soil erosion from leaving the site or entering the drainage system until:
      (a) Seed and mulch have been placed in non-paved areas.
      (b) Aggregate has been placed in bituminous and gravel areas.

c. Dewatering discharge.
   (1) Place bales of hay, straw and/or siltation fencing at point of discharge, adequately anchored.

d. Maintain controls during non-working hours and during working hours if weather so requires.

e. Remove silt or solids retention at control structures following construction.

END OF SECTION 31 32 11.1
SOIL SURFACE EROSION CONTROL

SECTION 33 30 11.1

SANITARY SEWERS

PART 1 – GENERAL

1.01 DESCRIPTION:

A. This section includes the work required for sanitary sewer pipe, structures, and appurtenant work.

1.02 DEFINITIONS:

A. Line and grade control terminology: SEE PLAN DETAIL.

1.03 SUBMITTALS:

A. Submit the following in accordance with SECTION 01 33 00 – SUBMITTAL PROCEDURES:

1. Shop drawings on radius pipe.
2. Manufacturer's air or vacuum test results on concrete pipe.
3. Manufacturer’s certificate for materials provided

B. Contractor shall report witness measurements and "as-built" elevation on end of service lines.

1. Provide measurements from three permanent fixtures such as building corners, power poles and trees 8-inch diameter and larger.

C. Report presence of underground utilities and drains.

1.04 JOB CONDITIONS:

A. Maintain existing sanitary sewer system operational.

B. Do not bypass wastewater to ground or surface waters.

C. Install service lines as pipe laying progresses and within maximum of 600 feet of mainline sewer installation.

D. Cleanup promptly following pipe installation and within maximum of 400 feet behind pipe laying operation.

PART 2 - PRODUCTS

2.01 PIPE:

A. Classification Table:

Type and Size	Design Depth (feet) D1 5-10	D2 10-19	D3 over 19
Plastic Truss (PVC) 8" - 15"	ASTM D 2680	ASTM D 2680	ASTM D 2680
Plastic (PVC) 4" - 18"	ASTM D 3034-SDR35	ASTM D 3034-SDR35	ASTM D 3034-SDR35
Plastic (PE) 4" - 6"	ASTM D 2239-SDR 15 Series 60	ASTM D 2239-SDR 11.5 Series 80	ASTM D 2239-SDR 9 Series 100

B. Service Pipe (laterals): Provide minimum 6 inch, same classification as mainline pipe.

C. Plastic Pipe: Provide seating marks where couplings are used for jointing.

1. Joints: Provide rubber "o" ring.

D. Joint Repair or Connecting to Existing Sewer Pipe of Different Material:

1. Provide Fernco adapter coupling and stainless steel bands.

E. Provide Joint Materials as Indicated for the Following Pipes:

1. Plastic Truss (PVC): Premium gasketed joints, ASTM D2680.
2. Plastic (PVC): ASTM D3034.
3. Plastic (PE): ASTM D2239

2.02 MANHOLES:

A. Manholes shall be precast units.

B. Precast Units: ASTM C478, modified for "o" ring gaskets.

1. Pipe Openings: Provide flexible, watertight rubber boot using mechanically compressed flexible joint re-seal, link-seal, Pressure Wedge II, Kor-N-Seal, or equal. Conform to ASTM C923.

C. Concrete Brick: ASTM C55, Grade N-1

D. Grade Rings: ASTM C478. Note: Ladtech HDPE adjusting rings are a suitable alternate.

E. Mortar: ASTM C270: 1 part Portland cement, 1 part lime and 3 parts sand by volume.

F. Manhole Steps:

1. Plastic with 3/8-inch steel rod reinforcement.
2. Dimensions: 10-inch deep by 10-inch wide, 5-inch tread depth.

G. Standard Manhole Castings: East Jordan 1120 C cover or Neenah R-1764 - 2 hole cover; with letter S.

H. Watertight Manhole Castings: East Jordan 1040 ZPT or Neenah R-1916 F; with letter S.

I. Bituminous Waterproofing: ASTM D449.

J. Joint Waterproofing: CRETEX, Infi-Shield exterior joint wrap or approved equal. Apply to joints and casting/chimney/adjustment rings.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Alignment and Grade:

1. Deviations: Notify ENGINEER and obtain instructions to proceed where there is a grade discrepancy or an obstruction not shown on the plans.
2. Laser Beam Control:
   a. Check grade: at set-up point, 25 feet, 50 feet, 100 feet and 100 foot points thereafter to the next set-up point.
   b. Projector advancement: Reset at each manhole.

B. Bedding:

1. Method: SEE PLAN DETAILS.
2. Provide bedding area backfill in accordance with SECTION 31 23 00 EXCAVATION AND FILL.
3. Provide continuous bearing by supporting entire length of pipe barrel evenly.

3.02 INSTALLATION:

A. Laying Pipe:
1. Direction shall be upstream with spigot or tongue end downstream and bell end upstream.
2. Joints shall be smooth and clean.
3. Place pipe length and bedding as a unit in a frost free, dry trench.
4. Special supports and saddles: SEE PLAN DETAILS.

B. Jointing:

1. Provide solvents, adhesives and lubricants as furnished by Manufacturer.

2. Gasket position: Confirm that the gasket is in place and that the joint is properly made.

C. Manholes:

1. General: SEE PLAN DETAILS.
2. Base bedding: Provide 4" pea stone with full and even bearing in impervious soils or wet conditions. Otherwise provide on undisturbed frost-free dry subgrade.
3. Fill joint space completely and trowel between sections of precast units.
4. Grout annular space between manhole wall and flow channel and pipe.
5. Provide casting grade setting as follows:
   a. Existing pavement: Finished grade.
   b. Gravel or lawn grade: 4 inches below.
   c. Unpaved areas: Finished grade.
6. Provide waterproofing on ASTM C478 manholes:
   a. Bituminous: Apply 1 gallon per 100 s.f. to outside free of holidays and open pin holes.
7. Provide flexible seal on all joints including: chimney, casting, adjustment rings, and each barrel section joint for entire manhole. Surface preparation required to install seal material shall be in accordance with the manufacturer's instructions.

D. Connections:

1. Connect to existing sanitary manhole by coring drilling a flexible manhole connection meeting ASTM C923 to receive an opening adequate to insert pipe and secure circumference of pipe with non-shrink cement mortar.
   a. Relay and repoint loose blocks and bricks on existing block and brick structures. Re-channel flowlines and benches with concrete.
   b. System carrying wastewater: by-pass pumping as necessary to complete work.

E. Service Lines (laterals):

1. Align at right angles to street or easement line.
2. Grade: Provide at uniform rate from connection or main riser to the property or easement line, minimum 1/8 inch per foot. (1%)
3. Provide minimum depth at street right-of-way line, property line, or easement line as follows:
   a. Commercial and industrial buildings, schools, churches: As determined in field by ENGINEER.
   b. The above depths govern, except that the minimum depth at the right-of-way line or property line shall be 10 feet below street or easement centerline grade unless otherwise permitted by ENGINEER. Property line riser excluded from this requirement.
4. Connection fitting:
   a. Locate as directed by ENGINEER in field.
   b. 45 degrees or 60 degrees Wyes: Provide on all pipe except concrete pipe.
   c. Tees: Allowed only on reinforced concrete pipe.
5. Main riser will be allowed where cover exceeds 13 feet at mainline, and meets R.O.W. requirements.
6. Plugging: Provide standard plugs or caps securely blocked.

7. Markers: Provide 1/2" steel rod, extended from lateral invert to 4 inches below grade.
8. Witnesses: Report the following to the ENGINEER:
   a. Wyes and Tee: Measurement to nearest downstream manhole.
   b. Markers: 3 measurements to permanent surface features.
9. Property line riser: Provide on all services. SEE PLAN DETAILS.

3.03 TESTING AND INSPECTION:

A. General:

1. Supervision: By ENGINEER.
2. Testing: Perform upon completion and before connecting to active system.
3. Leakage tests: Provide promptly following installation of sewer pipe including services, and keep within maximum 1200 feet behind pipe laying operation.
4. Notification: Clean, pretest and arrange with ENGINEER for final inspection and test.
5. Provide necessary equipment, manpower and assistance.

B. Line and grade: Allowable drift between structures from proposed alignment will be as follows.

1. Line:
   a. Thru 36 inch: 0.20 foot.
   b. Over 36 inch: 0.40 foot.
2. Grade:
   a. Thru 36 inch: 0.02 foot.
   b. Over 36 inch: 0.05 foot.

C. Plastic pipe deformation:

1. Pipe deflection will be limited to 5 percent of diameter.
2. Pull GO, NO-GO type gauge through pipe. SEE PLAN DETAILS.
3. Schedule: Conduct after final backfill has been in place a minimum of thirty (30) days, and after shutdown of dewatering operation.

D. Leakage Testing:

1. Acceptable leakage will be as follows:
   a. Water: Less than 200 gallons per inch of pipe diameter per mile of pipe per 24 hours. (test permitted only when service laterals are not present, and approved by ENGINEER)
   b. Air: Holding time not less than that listed in table. SEE PLAN DETAILS.
2. Correction: Repair defects and repeat test until acceptable.
   a. Method of repairing defects shall be approved by ENGINEER.

3.04 ADJUST AND CLEAN:

A. General: Keep pipe and structures clean as work progresses.

B. Exfiltration Air Test Table.

END OF SECTION 33 30 11.1
SANITARY SEWERS

SECTION 33 40 01.1

STORM DRAINAGE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section includes work required for storm sewer pipe, structures and related work.

1.02 DEFINITIONS:

A. Line and grade control terminology: SEE PLAN DETAILS

1.03 SUBMITTALS:

A. Submit the following in accordance with SECTION 01 33 00 – SUBMITTAL PROCEDURES.

1. Shop Drawings on radius pipe.

B. Notify ENGINEER on presence of wastewater:

C. Line and grade control method other than Laser Beam shall be approved by ENGINEER.

D. Contractor shall provide witness measurements and "as-built" elevation on end of footing drains.

1. Provide measurements from three permanent fixtures such as building corners, power poles and trees 8-inch diameter and larger.

1.04 JOB CONDITIONS:

A. Maintain existing storm sewer operational.

B. Install service lines, catch basins and inlet leads as pipe laying progresses and within maximum of 600 feet of mainline sewer installation.

C. Clean-up promptly following pipe installation and within maximum of 400 feet behind pipe laying operation.

PART 2 – PRODUCTS

2.01 PIPE:

A. Concrete Pipe Classification Table:

Type and Size	Design Depth (feet) 3-10	10-19	Over 19
Reinforced Concrete 12" - 54"	ASTM C-76 Class III	ASTM C-76 Class III	ASTM C-76 Class IV
Reinforced Concrete 60" - 90"	ASTM C-76 Class II	ASTM C-76 Class III	ASTM C-76 Class IV

B. Reinforcement: Concrete Pipe reinforcing shall be circular.

C. Footing Drains:

1. PVC: ASTM D 3034-SDR 35 with premium joints.
2. Fittings: Connect to storm sewer with tee or Kor-N-Tee connector (flexible rubber boot) or equal.

D. High Density Polyurethane (HDPE): Smooth lined corrugated Meeting AASHTO M 294

2.02 PREMIUM JOINTS:

A. Concrete: ASTM C443, modified to include "O"-rings on grooved pipe ends.

B. HDPE: AASHTO M252 or M 294, ASTM D3212.

2.03 MANHOLES, CATCH BASINS AND INLETS:

A. Precast Units: ASTM C478 and ASTM C76 Class III.

1. Joints: Cement mortar, preformed bituminous rope or "o"-ring gaskets.
2. Pipe openings: Pipe diameter plus 6 inch, maximum.

B. Concrete Radial Units: ASTM C139.

C. Grade Rings: ASTM C478. Ladtech HDPE adjusting rings are a suitable alternate.

D. Manhole Steps:

1. Plastic with 3/8 inch steel rod reinforcement.
2. Dimensions: 10-inch deep by 10-inch wide, 5-inch tread depth.

E. Manhole Castings: East Jordan 1120, B cover, Neenah 1764 perforated cover.

F. Catch Basin and Inlet Castings: SEE PLAN DETAILS.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Alignment and Grade:

1. Deviations: Notify ENGINEER and obtain instructions to proceed where there is a grade discrepancy or an obstruction not shown on the plans.
2. Expose existing utilities at crossings of proposed storm sewer in advance of laying pipe to verify existing depth. Advise ENGINEER of conflicts in grade and provide adjustments in grade of storm sewer at no additional cost to OWNER.

B. Laser Beam Control:

1. Check grade at set-up point, 25 feet, 50 feet, 100 feet and 200 foot points thereafter to the next set-up point.
2. Laser advancement: Reset at each manhole.

C. Bedding:

1. Method: SEE PLAN DETAILS
2. Provide bedding area backfill in accordance with SECTION 31 23 00 EXCAVATION AND FILL.
3. Provide continuous bearing by supporting entire length of pipe barrel evenly.

3.02 INSTALLATION:

A. Laying Pipe:

1. Direction shall be upstream with spigot or tongue end downstream and bell end upstream.
2. Joints shall be smooth and clean.
3. Place pipe length and bedding as a unit in a frost free, dry trench.
4. Special supports and saddles: SEE PLAN DETAILS

B. Manholes, Catch Basins and Inlets:

1. General: SEE PLAN DETAILS
2. Base bedding: Provide 4 inches of pea stone with full and even bearing in impervious soils or wet conditions. Otherwise provide on undisturbed frost-free dry subgrade.
3. Adjusting rings: Set in full bed of mortar, joints maximum 1/2 inch at inside face and wipe joints. Plaster coat complete interior of structure with 1/2-inch coat of cement mortar. For HDPE adjusting rings, follow manufacturers installation instructions.
4. Provide manhole casting grade setting as follows:
   a. Existing pavement: Finished grade.
   b. Gravel or lawn grade: 4 inches below.

c. Unpaved areas: Finished grade.

5. Provide catch basin casting grade setting as follows:
   a. Gutter grade: 1/2 inch below.

C. Connections:

1. Existing storm sewer:
   a. Structures: Relay and repoint loose blocks and bricks.
2. Future Storm Sewer:
   a. Bulkhead: Pipe 24 inch and larger with brick and mortar, 1/2 inch plaster outside.
      (1) up to - 36 inch: 4 inch thick
      (2) 42 inch - 60 inch: 8 inch thick
      (3) 60 inch & larger: 12 inch thick

3.03 GENERAL CONSTRUCTION and TOLERANCES:

A. General:

1. Coordination: By ENGINEER.
2. Completion: Before connecting to active system.
3. Notification: Clean and arrange with ENGINEER for inspection.
4. Keep pipe and structures clean as work progresses.

B. Line and Grade Tolerances: Allowable drift between structures from proposed alignment will be as follows:

1. Line:
   a. Thru 36 inch: 0.40 foot.
   b. Over 36 inch: 0.80 foot.
2. Grade:
   a. Thru 36 inch: 0.05 foot.
   b. Over 36 inch: 0.10 foot.

END OF SECTION 33 40 01.1
STORM DRAINAGE